ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LVIII, No. 12. CHICAGO, SATURDAY, MARCH 25, 1911. ISSUED WEEKLY.

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY
CHARLES W. PRICE, President and Treasurer.
A. A. GRAY, General Manager. H. S. TUTHILL, Secretary.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: MARQUETTE BUILDING, CHICAGO

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall, Manager.

CHARLES W. PRICE.....Editor-in-Chief
A. A. GRAY.....Managing Editor
MORTON GITHENS LLOYD.....Technical Editor
F. H. BERNHARD.....Associate Editor
HOWARD EHRLICH.....Associate Editor
C. H. SEAVER.....Associate Editor

SUBSCRIPTIONS.

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

CONTENTS.

EDITORIALS 577
Chicago Committee for Smoke Elimination 580
Merriam Electric Club 580
The Incandescent Lamp Suits 580
Program of Meeting of American Electrochemical Society 580
Dedication of the Roosevelt Dam 580
John I. Beggs 581
Atmospheric Conductivity at High Altitudes 581
The Rusting of Iron 581
Hearing on Bill for Licensing Engineers 582
Conference on Water-Power Sites 582
Examination for Draftsmen 582
The Power System of the Southern California Edison Company.—I.—By W. B. Gump 583
Three Hundredth Meeting of the New York Electrical Society 589
MINNESOTA ELECTRICAL ASSOCIATION 590
Safety in Line Construction 590
Window and Sign Lighting 590
Testing Wattmeters 590
Day Load for Central Stations 590
Residence Lighting 591
Incandescent Lamp Improvements 592
Gas-Producer Engines for Central Stations 592
Insurance 592
Gasoline Competition 593
RAILWAY MEN MEET IN CHICAGO 594
American Railway Engineering and Maintenance of Way Association 594
Railway Signal Association 594
Railway Appliances Association 595
Central Electric Railway Association 595
Economy of a Producer-Gas Plant 596
Hydroelectric Plants for Milan, Italy 596
Equipment for Jacksonville Station 596
European Switchboards of Steel, Iron and Concrete.—By Stephen Q. Hayes 597
Chicago Section, Illuminating Engineering Society 604
Meeting of the New England Section, National Electric Light Association 604
Improvements in Washington Street Lighting 605
Boiler Inspection in New York 605
Sanitary District Current to be Supplied to the South Parks, Chicago 606
Annual Report of the American Telephone & Telegraph Company 609
Life of Primary Batteries 609
Wireless Man Reindicted 609
German Cable to South America 609
Interstate Commerce Commission to Define its Relation to Telephone Companies 609
Electrical Power in an Artificial Ice Plant 610
Electrical Equipment for Shipyard 610
The Distribution of Electric Power 611
A Gas-Engine and Steam-Turbine Plant 611
NEW ELECTRICAL AND MECHANICAL APPARATUS AND APPLIANCES 612
CURRENT ELECTRICAL NEWS 617
PUBLIC SERVICE COMMISSION NEWS 617
RECORD OF ELECTRICAL PATENTS 622

Copyright, 1911, by the Electrical Review Publishing Company.

TERMINAL ELECTRIFICATION IN CHICAGO.

The smoke-laden atmosphere of Chicago has long been a source of discomfort and economic loss to its citizens and a subject for continual discussion among those responsible for its existence and those interested in its abatement. It has been shown definitely that the steam locomotives on the railroads entering the city are the chief sources of smoke and that the only solution to the question of smoke abatement is the electrification of the railroad terminals. We are pleased to note that another step has been taken towards this end and it is to be hoped that the effort will not be entirely futile.

The Chicago Association of Commerce has appointed a commission consisting of some of its own representative business men, of railroad executives, and of city officials, such as the health officer and the smoke inspector, who have been interested in improving the conditions. This commission may, therefore, be regarded as representing the railroads, the advocates of electrification and the general public. The investigation which will be conducted is expected to consider all the phases of the problem including the engineering and the financial aspects.

The railroads have shown their appreciation of the necessity for an investigation of this kind along broad lines by offering to pay the necessary expenses, and the technical end of the investigation will be carried on by a chief engineer and a staff of assistants entirely competent to work out the engineering problems involved. The work is being undertaken with the approval of the city officials and the co-operation of the mayor and city council, who respectively selected and confirmed the representatives of the city upon the commission.

With the example of New York before them, it would seem that this commission should be able to find a practical solution of the problem of doing away with the steam locomotive within the city limits of Chicago. The conditions of traffic there are such as not only offer opportunities for electrification on the regular passenger lines, but also in the handling of freight, which reaches a volume and a complication of interchange probably unknown elsewhere in the world. While it is to be expected that this investigation will require considerable time, the advocates of electrification will be satisfied if the result is ultimately reached.

COMPETITION WITH ISOLATED GAS-ENGINE PLANTS.

One of the most difficult types of power equipment to dislodge from isolated-plant service is the gas-engine installation which runs on the mains of the local gas company. The central-station manager usually finds himself handicapped in such cases by a considerable investment in machinery, by the natural disposition of the plant owner to overlook the real costs of maintaining an independent service and by the belief of the existing operating force that nothing can be gained through a change to a purely electrical system of supplying power.

A recent investigation of the cost of service in a seventy-five-kilowatt gas-electric isolated plant is suggestive. The equipment consisted of three two-cylinder, four-cycle, forty-horsepower vertical gas engines running at a rated speed of three hundred revolutions per minute, each being direct-connected to a 25-kilowatt, 250-volt, compound-wound, direct-current generator. The auxiliaries consisted of a balancer set for the local three-wire system, a motor-generator set for charging ignition storage batteries, a motor-driven air pump and storage tanks for starting the engines, and a small switchboard.

Examination of the plant disclosed the fact that the generators suffered severely from sparking and a hot commutator, on account of severe overloads due to the starting of elevators in the store served by the installation. The gas supply was delivered from the local mains at a pressure of two inches of water, and was measured by two 300-light Tufts meters connected in parallel. A specially calibrated meter was used in making efficiency tests, and the quality of the gas was determined by a long series of calorimeter tests, special care being taken to obtain a constant outlet temperature of the water and a flame adjustment for maximum heating before beginning the readings. The plant was operated under normal working conditions without any adjustments of the engines or generators. The balancer set was connected inside the wattmeter terminals and the power which was supplied to it was charged to the heat losses within the installation. The average calorific power of the gas was 564.8 British thermal units per cubic foot, and the all-day thermal efficiency of the plant was found to be 18.6 per cent. The average cost of gas was 68.15 cents per thousand feet.

The tests showed that the actual cost of operation per kilowatt-hour was as follows: water, 0.224 cents; gas, 2.21 cents; oil, 0.163 cents; waste and kerosene, 0.011 cents; attendance, 1.55 cents; interest charge, 0.585 cents; depreciation charge, 0.736 cents; taxes, 0.117 cents; maintenance and repairs, 0.106 cents; total, 5.702 cents. The principal factors in reaching this figure are worth noting. The plant used 529 cubic feet of water in a day's run of 9.75 hours; its gas consumption was 9,950 cubic feet; oil used, two gallons; plant output in day's run, 306.6 kilowatt-hours; operators' wages, $28 per week of fifty-two hours; cost of oil, 25 cents per gallon; waste, 9 cents per pound; kerosene, $4 per barrel; water, 13 cents per hundred cubic feet. The allowances for fixed charges were: interest, 5 per cent; depreciation, 6.28 per cent (twelve years' life, compounding the allowance); insurance and taxes, one per cent; maintenance and repairs, $100 per year—an extremely modest allowance for the upkeep of an equipment of small internal-combustion engines. The initial cost of the plant was $11,000. It is clear from the test that the claim that a small gas-engine-electric plant can be operated at a total yearly expense of two or three cents per kilowatt-hour is one which can be substantiated only in the most favorable cases. An analysis of the test data and working conditions in the above plant by the engineers in charge of the test shows still more conclusively the difficulty of cutting the yearly costs below three or four cents per kilowatt-hour.

The most ideal condition under which the plant could operate would be at its rated capacity, seventy-five kilowatts. The effect of this increase in the energy output would be to materially lower the fixed charges per unit delivered to the busbar, but on account of the excellent thermal efficiency of the plant, it is apparent that the cost of gas per kilowatt-hour cannot be decreased to any appreciable extent. The cost of labor, however, would drop from 1.55 to 0.65 cents per kilowatt-hour; the interest charge would fall from 0.58 to 0.246 cents; depreciation would drop from 0.736 to 0.309 cents, and insurance and taxes from 0.117 to 0.049 cents, making a resulting total cost of 3.951 cents per kilowatt-hour, assuming that full-load operation could be maintained for the entire working day.

Considering the service which the plant is called upon to give, in the face of unsteady and frequent 200-per-cent loads on account of the elevator service, it would scarcely be possible to obtain an average load of over fifty kilowatts. This would necessitate the continuous running of two generators, which might be able, owing to their overload capacity, to handle the momentary peaks. The ability of the equipment to handle such service would depend largely upon the duration of the overloads, since the gas engine has very little overload capacity in addition to that stored in its flywheel. The third unit would necessarily be held in reserve during the earlier hours of each day, but would have to be utilized as the lighting peak came on. The cost of operation, including fixed charges, at an average load of fifty kilowatts, the highest practicable continuous loading under the conditions, figures 4.506 cents. In spite of the excellent station factor of the plant on a 9.75-hour day, therefore, it is clear that about 4.5 cents is the lowest possible yearly cost per unit which could be attained in this plant. This rate could be met by many central stations.

MINNESOTA ELECTRICAL ASSOCIATION.

It is indeed gratifying to note the great strides that have been made by the Minnesota Electrical Association during the few years of its organization. The fourth annual convention which was recently held in St. Paul gave conclusive evidence of this growth and development and leaves the impression that still greater strides are to be looked for. The amendment to the constitution admitting to membership in the association central-station men from North and South Dakota, is, of course, in a measure responsible for the larger attendance at the St. Paul meeting, but to the spirit and interest of the members, and particularly the work of the last administration, is credit due for the very commendable showing made.

One of the significant phases of the proceedings was a suggestion made by Mr. Ludwig Kemper in a paper entitled "Curb Lighting," which was presented on the first day. It was urged that a committee be appointed to collect comprehensive, accurate data on existing ornamental street-lighting installations, this to be supplemented with illustrations in the form of lantern slides of typical installations. The material thus collected should become the property of the association and be available for any member for use in connection with local campaigns.

While action of this kind is not original, it is certainly infrequent. Too many associations, whether on account of lack of interest or lack of funds, content themselves with holding a convention and transacting the customary business apparently without thought to the real, measurable benefits to be derived.

OUR MOST PRECIOUS METAL

We called attention some weeks ago in these columns to the increasing scarcity of platinum and the difficulty of securing a supply sufficient to meet the wants of the manufacturers. The use of platinum has been rapidly increasing in a number of industries, there being a very large demand for it not only by electrical manufacturers, as in the lines of telephone equipment, sparking plugs and other apparatus where a good contact is required, but also in the jewelry business, in dental practice, by chemists and for photographic prints.

While the demand has thus been steadily increasing, the supply has been unable to keep pace with it, as the sources of production of this metal are very limited. The chief supply comes from the Ural Mountains in Russia, and the majority of the platinum used in this country has to be imported. Only about one per cent of it is produced here. This small amount comes from the gold placers of the Pacific Coast, the output from this source in 1909 amounting to only 672 troy ounces. A small quantity is also mined in Canada and in the United States of Colombia.

The cost of extraction has been increasing with the exhaustion of the mines in Russia giving the best yields, and this, in connection with the steadily increasing demand, has caused the price of platinum to mount steadily upward. Recent quotations for this metal have reached the record of $43.00 an ounce for the hard metal and $41.00 an ounce for the soft metal. The latter represents commercially pure platinum, the term hard platinum being applied to an alloy with the metal iridium, which is an equally refractory and dense metal which gives increased resisting qualities to the platinum.

Previous to this year the record price for platinum was reached in 1906, when the pure metal sold for $38.00 an ounce. In 1908 the market declined and the price went as low as $20.00 an ounce. Since then a steady increase has been experienced and it is to be expected that under the existing conditions as noted above the price will continue upward. The importations in 1908 amounted to only $1,229,873, whereas in 1909 there was an increase to $2,973,948.

It is to be noted that at the present quotation the price of platinum is more than twice as great as that of pure gold, the latter being worth only $20.67 an ounce. In comparison, therefore, it is a cheap and common metal.

CONFERENCE ON WATER-POWER SITES.

The disposition of the water-power sites of the country is a very important matter and has been claiming considerable attention of late not only from our Government officials, but from the general public. The water powers represent one of our most valuable natural resources, since they not only can furnish a very valuable commodity, but can do so indefinitely, the supply being inexhaustible. A large number of the water powers in the West are in streams which flow through or past public lands and it is impossible to develop the water powers without making use of these adjacent lands. The control of the water-power sites consequently has rested in the hands of the federal Government. There has been considerable discussion, but as yet little unanimity of opinion as to whether the regulation of the use of these water powers should be retained by the federal Government or should be turned over to the various state Governments within whose borders these sites are located. It is of vital interest that the question should be settled in some definite way.

There seems to be stagnation in Washington at present in regard to this question and the more public discussion that it obtains the sooner there is likely to be some definite settlement in regard to the policy of the federal administration on this subject. Every opportunity for public discussion is therefore to be welcomed. As noted elsewhere in this issue, a conference has been called by the Power Transmission Section of the National Electric Light Association to discuss this subject, and a definite series of topics has been drawn up which will insure the discussion by able speakers of some of these mooted questions.

Chicago Committee for Smoke Elimination.

The question of smoke elimination in Chicago has resulted in the selection of a committee of seventeen Chicago business men, city officials and railroad executives, who have been delegated by the Association of Commerce to make a thorough investigation of the smoke problem.

In order that the best study of conditions may be made, a chief engineer will be chosen and a corps of assistants employed, the railroad companies agreeing to pay all costs incurred in the work. Permanent headquarters are to be established and regular meetings are to be held by the committee.

When a solution of the matter is reached, any action taken will be with a view of making all fundamental improvements in railway traffic that the best interests of the city and the railroads demand.

Members of the committee which was appointed are as follows: Paul P. Bird, chief smoke inspector; T. E. Donnelley, chairman city smoke commission; Dr. W. A. Evans, commissioner of health; Milton J. Foreman, chairman Local Transportation Committee of the City Council; W. A. Gardner, president Chicago & Northwestern Railroad; H. G. Hetzler, president Chicago and Western Indiana Railroad; Darius Miller, president Chicago Burlington & Quincy Railroad; C. E. Schaff, vice-president New York Central lines; W. F. M. Goss, dean college of engineering, University of Illinois; E. R. Graham, of D. H. Burnham & Company; Richard C. Hall, president Duck Brand Company; Jesse Holdom, attorney at law; Harrison B. Riley, president Chicago Title & Trust Company; John W. Scott, Carson, Pirie, Scott & Company; Francis T. Simmons, Francis T. Simmons & Company; Mason B. Starring, president Northwestern Elevated Railroad; Frederick H. Rawson, president Union Trust Company.

Merriam Electric Club.

Politics in the city of Chicago has taken a rather peculiar turn, and for the first time it is believed in the history of the city that the representatives of various departments of industry are taking an active part in the support of the local candidates. There has recently been organized in Chicago the Merriam Electric Club, and this is being supported by some of the most prominent electric men in the city.

The officers are: President, W. W. Low, Electric Appliance Company; first vice-president, N. G. Harvey, Illinois Electric Company; second vice-president, C. G. Atkins; secretary, W. R. Pinckard, Westinghouse Electric and Manufacturing Company. There is an executive committee of one hundred members, among whom are some of the most prominent representatives of the leading houses in the electrical industry in Chicago.

The Incandescent Lamp Suits.

It is understood that the first hearings in the suit of the Department of Justice against the manufacturers of incandescent electric lamps will be heard in the Circuit Court of the United States for the Northern District of Ohio, at Cleveland, O., on Monday, May 1. The defendant companies will be represented by attorneys and briefs will be submitted. In this connection it has been announced that the prices of all incandescent lamp bulbs will be reduced considerably. It is stated on good authority that the question of reducing the price of incandescent-lamp bulbs has been under consideration for a number of months. It is probable that new prices involving substantial reductions will be put into effect in the reasonably near future, although the details have not yet been decided upon. This action, if taken, will be influenced in no way by the Government suit against the lamp companies. Such revision of prices as may be decided upon will be in accordance with the policy which the lamp manufacturers have followed for a long time, namely, that of reducing the prices of incandescent lamps as greater experience in manufacture and increased demand for the newer types has made it practicable to effect reductions in the manufacturing cost.

Dedication of the Roosevelt Dam.

The Roosevelt Dam, the principal feature of the Salt River Project, which has been developed by the United States Reclamation Service in the Salt River Valley, Ariz., was dedicated by Theodore Roosevelt on March 18. The Salt River Project is the first to be thus dedicated since reclamation work was instituted after the proclamation establishing the Reclamation Act by President Roosevelt on June 17, 1902.

Roosevelt Dam is situated at the head of the Salt River canyon, just below the confluence of Tonti Creek and the head waters of the Salt River, seventy-two miles from Phoenix, Ariz. The Roosevelt Dam is a rubble-masonry arch, 280 feet high, with a top length of 1,080 feet, including the spillways. The length at the bottom is 235 feet.

The hydroelectric development at the Roosevelt Dam includes a power canal with a turbine capacity of 4,400 horsepower and turbines of 3,000 horsepower from the Roosevelt reservoir. The project includes both a gravity and pumping system of irrigation, current being conveyed to pumps in the Sacaton Indian reservation over duplicate three-phase transmission lines, with a switching station at Mesa, about eighteen miles from Phoenix. There is also a three-phase transmission line from Mesa to Phoenix. Ultimately there will be a large electrical development for power users all over the Salt River Valley.

Program of Meeting of American Electrochemical Society.

The program of papers for the annual meeting of the American Electrochemical Society, to be held in New York City, April 6, 7 and 8, has been announced. In addition to papers already read before the sections, it includes the following:

Report of the Committee on Standard Tests for Dry Cells, by C. F. Burgess.

Papers on New Electric Furnaces, by F. A. J. Fitzgerald, M. M. Kohn, J. W. Richards, A. Hiorth, and Carl Hering.

Electrically Fused Alumina as a Refractory, by L. E. Saunders.

The Condensation of Zinc from Electric Furnaces, by F. T. Snyder.

The Electrolytic System of Amalgamating Gold Ores, by E. E. Carey.

The Electrolytic Corrosion of Electroplated Objects, by W. S. Landis.

Some Problems of the Electroplater, by G. B. Hogaboom.

The Haas-Oettel Electrolytic Cell, by E. E. Niswonger.

Electrical Heating for Preventing Superheating of Liquids, by J. H. Matthews.

A Mercurous-Perchlorate Coulometer, by F. C. Mathers.

Electric Discharges, by L. A. Parsons.

The Mechanism of Electrolytic Transfer, by J. W. Richards.

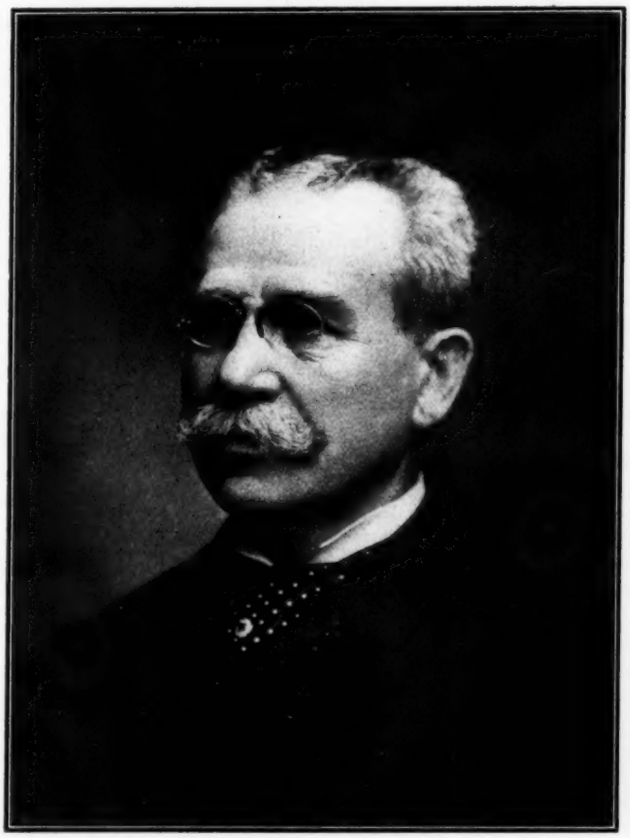
Electric Steel Processes as Competitors of the Bessemer and Open-Hearth, by A. E. Greene.

J. W. Turrentine will give an exhibition of the Schoenherr Arc for fixing atmospheric nitrogen and there will be visits to a number of interesting electrical and electrochemical plants.

John I. Beggs.

Long before the wave of popular opinion with respect to the regulation of public-utility corporations had attained any volume a number of enlightened managers of public-utility properties were advocating the establishing of more cordial relations with the public and the adoption of publicity as a means of educating the public to an appreciation of their relation with the public-utility corporations.

At state and national conventions of street-railway and electric-light and power interests, the voice of John I. Beggs has often been heard making eloquent plea for modern methods in accounting, in establishing values for depreciation, in safeguarding the interests of the stockholder, and in establishing friendly relations with the public. A natural-born manager and diplomat of supreme judgment, Mr. Beggs has time and time again seen the ideas which he suggested much in advance of their practical adoption carried through to a very successful consummation.



JOHN I. BEGGS,
President, St. Louis Car Company.

Mr. Beggs has been identified with the management of public-service corporations for many years. In 1897, he took full charge of the company which preceded the Milwaukee Electric Railway and Light Company, and this was after a very successful connection with electric lighting and railway companies in Cincinnati. In 1897, when Mr. Beggs took hold of the Milwaukee organization, it had then just come out of great financial difficulties. Under the courageous administration instituted by Mr. Beggs, the property has been built up until now it is one of far-reaching ramifications and is conceded to be one of the strongest financially and as capably operated physically as any plant in the country.

Sketching rapidly the career of Mr. Beggs, it is discovered that he got into the electrical business as manager of a small electric lighting plant at Harrisburg, Pa., in 1884. Later on he was western manager of the old Edison General Electric Company. He then occupied various positions with other electrical undertakings until his connection with the Milwaukee institution. Mr. Beggs was elected president of the American Electric Railway Association in 1906.

Mr. Beggs has announced his retirement from the presidency of the Milwaukee Electric Railway and Light Company to go again into the manufacturing field. He becomes president and general manager of the St. Louis Car Company, at present one of the largest car-building concerns in the country. It is reported that Mr. Beggs has acquired a controlling interest in this organization. It is expected that he will go to St. Louis about April 1, and, while retiring from the management of the Milwaukee plant, he will retain his financial interest in the company and continue as one of its directors.

Atmospheric Conductivity at High Altitudes.

It is well known that the electrical conductivity of the atmosphere increases with altitude, and the same is true of the vertical currents of electricity in the air. Some interesting measurements of atmospheric conductivity in the high altitudes of the Bolivian Andes have been made by Walter Knoche and reported in the *Physikalische Zeitschrift*. The observations were taken at an altitude of 5,200 meters (17,000 feet).

Great difficulty was found in taking measurements at times, owing to the fact that the apparatus, as well as other objects, became charged from contact with the air, especially when a strong wind was blowing. The average value of the conductivity for positive charges was found to be about double that for negative charges, the values being 0.00085 and 0.0004 electrostatic units. The positive conductivity had a minimum about noon, with maxima early and late in the day. The negative conductivity was approximately constant. The high values of the conductivity are supposed to be due rather to a high velocity of the ions than to an excessive number of ions per unit volume. The maximum values observed for the conductivity were very high, the positive value reaching on one occasion 0.004 electrostatic units. At the same time the number of ions reached a value of 5,600 per cubic centimeter. The observations were taken in the summer of 1909.

The Rusting of Iron.

The results of the recent experiments of Bertram Lambert and J. Campbell Thomson on the rusting of iron are of some interest. They dealt with the purest materials procurable, iron, water, oxygen, and were conducted with vessels made of clear fused silica. The iron was obtained by reducing oxide (from ferric nitrate) in an electric furnace by means of electrolytic hydrogen. The pure materials did not rust when kept in contact for months; but the slightest impurity led to rusting, mostly within a few hours, even in the absence of all acid, including carbonic acid.

Hearing on Bill for Licensing Engineers.

The hearing before the Committee on General Laws of the New York Assembly on March 1 was upon the so-called Hoff bill which was based upon a draft prepared by a Committee of the American Society of Civil Engineers introduced with the proviso that the Society did not advocate the licensing of civil engineers, but if the adoption of a bill was imperative the Hoff bill was suggested.

Another bill was introduced at the instigation of the Technical League, and is known as the McGrath bill. This was referred to the Committee on Public Education and a hearing was given on March 14. The American Institute of Electrical Engineers was represented by Past-President Frank J. Sprague, Charles W. Stone, H. H. Barnes, S. D. Sprong, managers; E. A. Baldwin, chairman of the Schenectady Section, and Ralph W. Pope, secretary; the National Electric Light Association by President W. W. Freeman. Prominent officers and members of the American Society of Mechanical Engineers, American Institute of Mining Engineers, and American Society of Civil Engineers, were also in attendance, all being opposed to the bill, which was championed only by the counsel and president of the Technical League. The statement was made that the organization was composed of approximately 1,000 members scattered throughout the country, about 250 being employed in the State of New York. The object of the bill was stated to be the elevation of the profession and the protection of the people against incompetent civil engineering in public works. Messrs. Sprague and Stone spoke against the bill in behalf of the American Institute of Electrical Engineers and were supported by President Freeman of the National Electric Light Association, Colonel Meier, president of the American Society of Mechanical Engineers, Mr. Spilsbury representing the American Institute of Mining Engineers, President Boller of the American Institute of Consulting Engineers, and Mr. Francis of the American Society of Civil Engineers. After the hearing it was reported from various sources that the bill was not likely to be pushed in opposition to the practically unanimous disapproval from engineers of standing. The present danger appears to be that similar legislation may be adopted in other states which would be detrimental to the interests of engineers who have heretofore been practically free from interference of this nature.

Conference on Water-Power Sites.

A public conference will be held in the United Engineering Building, New York City, on Saturday, April 8, under the auspices of the Power Transmission Section of the National Electric Light Association, to consider the relations of the national and state governments to the conservation and utilization of water powers. Sessions will be held in the afternoon and evening, and addresses will be made by well known men, a program of which will be announced later. The following list contains some of the topics which it is proposed to discuss:

Shall the federal Government continue in control of the water-power sites or transfer them to the respective states wherein they are located?

If the latter, shall they turn them over without reservation or endeavor to impose restrictions?

Shall the federal Government concontrolled by federal or state Government, be transferred outright to the locater thereon for a consideration or without a consideration other than that they agree to develop them within a reasonable limit of time, or shall the water-power sites, whether owned by federal or state authorities, be leased to the locater and if so, shall there be a time limit and a basis of charge?

If a charge, shall this charge be an annual rental for the property based on the possibility of development or the actual development?

If on the actual development, shall the charge be arrived at on the basis of the minimum flow of water, or the actual amount of power generated and delivered therefrom, or the installed capacity in the generating station?

Contemplating, as is generally the situation, that the majority of the water-power sites, whether controlled by either federal or state Governments, cover only a very small proportion of the property as a whole utilized in the development of these propositions, shall or shall not this feature be taken into consideration in fixing the charges, if any?

If it is thought that it is best to grant a tenure for a definite time limit, what provision should be made in the original agreement as to the basis for renewing the rights to occupy the land?

In adjustment, what consideration should be given to the fact that the individual, company, or corporation occuying the site has a positive and individual ownership in the water, which ownership has been acquired direct from the State and in fee simple?

If it is finally concluded that the Government should retain ownership in the land, granting only an easement with a time limit and at the end of this time limit either the lease be renewed or the new owners come into possession of the property, what provision should be made as to the proper valuation, the latter to include that portion of the development located on the Government property, the ownership in the water, the pole-lines which are or are not on Government land, the substations wherever located, as well as the distributing circuits and motor installations therefrom? Shall they be valued on the basis of a replacement charge or on earning capacity?

Would it be better that either the federal or the state Government, whichever it is concluded should own these sites, should grant them in fee to the parties who will take and develop them within a certain given time and depend upon the public-service commissions to regulate the rates and service, as is being done now in certain states with street-railway and lighting companies?

Examination for Draftsman.

The United States Civil Service Commission announces that on April 22 an examination will be held at the regular places for the purpose of securing eligibles from which to fill a position as draftsman-cartographer in the Philippine service.

Those wishing to take the examination should apply to the Civil Service Commission at Washington or to the secretary of any board of examiners for examination form B. I. A. 2.

Exports of Copper.

Exports of copper for the week ended March 16 were 3,945 tons. The figure given since the first of the month is 12,196 tons.

The Power System of the Southern California Edison Company—I.

The Generating Stations at Redlands and Mill Creek.

BY W. B. GUMP.

INTRODUCTION.

The art of transmitting electrical energy at high potential has reached a development far in advance of anything which the predictions of a few years ago dared approach. Notwithstanding this fact there remains the necessity for vast improvement before long-distance transmission may be said to have reached its ultimate efficiency, or its complete reliability under all conditions of operation.

The early history of electrical transmission naturally centers around the Western States, and particularly Southern California, in which the city of Redlands lays claim to the first polyphase transmission system in the United States. Thus, from comparatively crude beginnings a system of plants was finally formed which today is second to none on the Pacific Coast, and ranks first among similar systems in this country.

The history of the Southern California Edison Company is significant in its relation to electric power transmission, and the historical data herein given is believed to be in harmony with the comprehensive description which is to follow.

In tracing the history of the Southern California Edison Company's present system back to its beginning we are led to a number of smaller interests which have been absorbed, and now compose one gigantic organization.

The origin of the present company dates back to a small concern, first known as the West Side Lighting Company, located at Los Angeles. As the business of this concern developed the name was finally changed to the Edison Electric Company. This company afterwards took in the Southern California Power Company, later the Pasadena Electric Light and Power Company, and, in the sequence given, the following interests were absorbed: the Santa Ana Gas and Electric Company, the Redlands Electric Light and Power Company, the California Power Company, and the Mountain Power Company. These interests composed the organization which until quite recently was known as the Edison Electric Company, but which at the present time bears the name of the subject of this article—the Southern California Edison Company.

THE REDLANDS PLANT.

Not until about January, 1892, did electric transmission reach a point which inspired sufficient confidence to warrant its commercial application over distances exceeding a few miles. At the time mentioned several capitalists, in conjunction with engineers, began to look favorably upon Redlands as a market for electrical energy, which was to be transmitted from a hydroelectric plant now known as Mill Creek No. 1. This project involved a transmission line of about eight miles. At that time Redlands was a promising

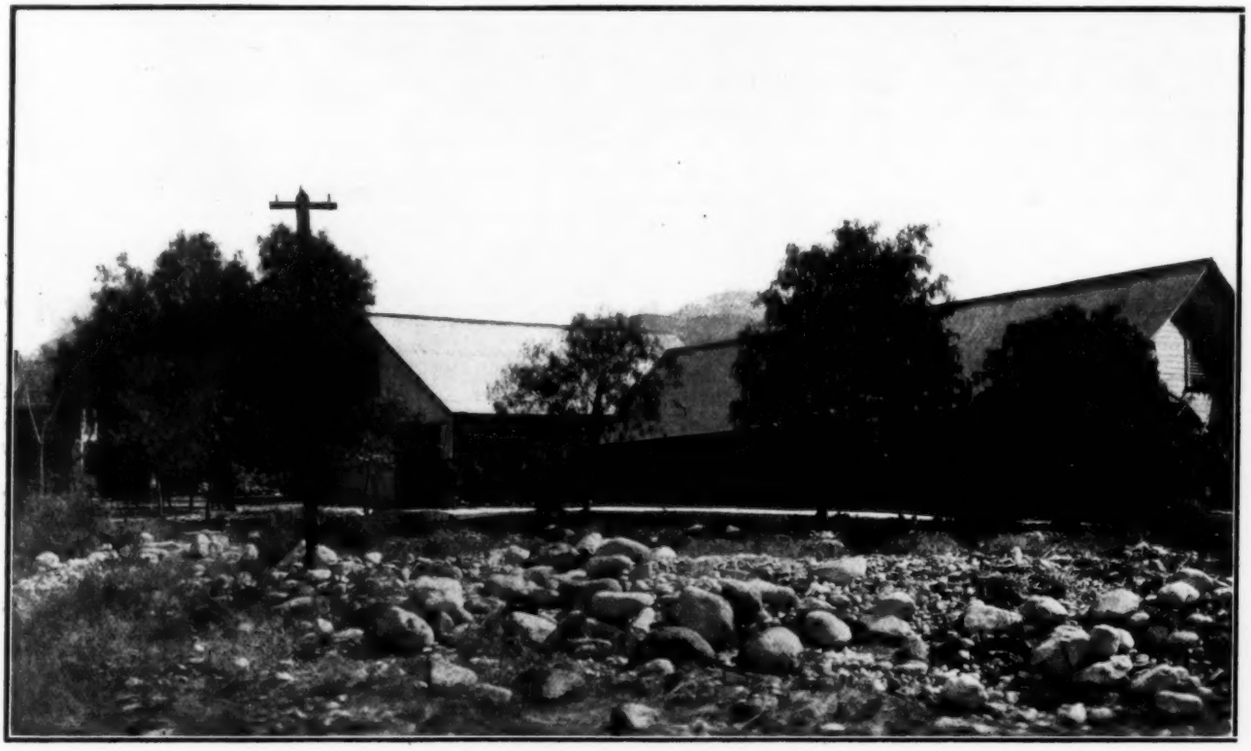


FIG. 1.—REDLANDS PLANT, NOW MILL CREEK NO. 1.

town of 4,500 inhabitants. Contemporary with this project a scheme was under way to transmit electric power from the plant of the San Antonio Light & Power Company over a single-phase line twenty-eight miles in length, at a potential of 10,000 volts, to be used for lighting. This plant was then commonly known as the Pomona Plant. It was constructed under the supervision of A. W. Decker, who afterwards became electrical engineer in charge of the Redlands project.

The Redlands system was incorporated in the early spring of 1892 by the residents of the town of Redlands, San Bernardino County, and was projected with the object of suplying light, heat and power for both domestic and commercial purposes, including the operation of street railways. The generating plant was located at the mouth of Mill Creek Canyon. Previous to this time Redlands was lighted entirely by oil,

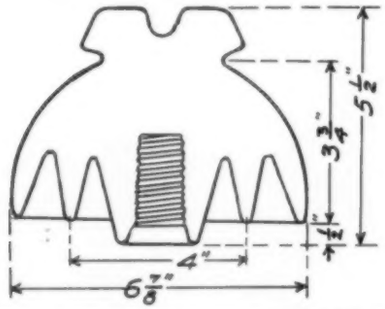


FIG. 2.—REDLANDS TYPE PORCELAIN INSULATOR.
Used on 33,000-Volt Lines.

excepting a few cases where private gasoline installations were used. With coal at $11 a ton the future of this vicinity was indeed bright.

The towns of Riverside and San Bernardino were each of about 10,000 inhabitants, and the distances at which they were located from Redlands by rail were fifteen and eight miles, respectively. The lighting for both towns was then being supplied by a hydro-electric generating plant driven by water from an irrigation canal which supplied the city of Riverside. In consequence of this method of deriving power the source of supply for lighting was very limited. This fact naturally favored the market for the Redlands plant, whose projectors looked forward to the electrification of the steam railroads then connecting these towns.

Prior to 1893 none of the towns of this section of the country developed more rapidly than Redlands. Not before 1886 had the land been plowed, or any cultivation on a commercial scale taken place. In 1887 a thrifty class of people began operations in and about Redlands, and their efforts started a development in the agricultural industry which today holds a distinguished place, especially in connection with the cultivation of oranges, which are recognized as first quality in comparison to any raised in this country.

It was appreciated at the inception of the Redlands project that the chief problem to be solved was that of transmission. A careful analysis of the conditions to be met displayed the fact that the design best adapted to these conditions would differ radically from that of the Pomona plant, or in fact any other plant in America at that time. In accordance with the requirements Mr. Decker finally advised three-phase transmission with a rated capacity of 400 kilowatts. Plans and specifications for this system were submitted to the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Siemens & Halske Electric Company, and the Electrical Engineering Company of San Francisco. As this plant was to mark an innovation in the realm of transmission a considerable amount of active correspondence and personal conference ensued before any of the aforesaid concerns were ready to make definite guarantees. The ground taken by these companies was that practically no reliable data was available to show that a high-tension transmission plant of this character could be successfully operated, and the use of apparatus then standard was strongly advised. This brings out the fact that much credit is due to the engineers who were pioneers in the field of transmission, since their persistent and persevering effort was unquestionably the chief factor in promoting high-tension development, and the present status of the art may be looked upon as a monument to their untiring labor.

Bids for the Redlands plant were finally put in by the General Electric, Westinghouse, and the Electrical Engineering Company, the latter proposing a 5,000-volt, direct-current transmission system, having direct-current motors coupled to single-phase alternators at Redlands. The General Electric bid proposed two 250-kilowatt, 2,400-volt, three-phase, Y-connected generators, running at 600 revolutions per minute, which after some changes was finally made the nucleus of the Redlands system. The Westinghouse Company proposed a two-phase system, which was not favored.

The original plant, now under the name of Mill Creek No. 1 Station of the Southern California Edison Company (Fig. 1), was driven by Pelton water-wheels, under a total head of 295 feet. The transmission line consisted of two three-phase circuits, each consisting of three No. 0 B. & S. bare copper wires extending to Redlands, a distance of seven and one-half miles, by pole line.

The type of insulator used on this line was a deep-groove, double-petticoat, glass insulator, designed for 2,300

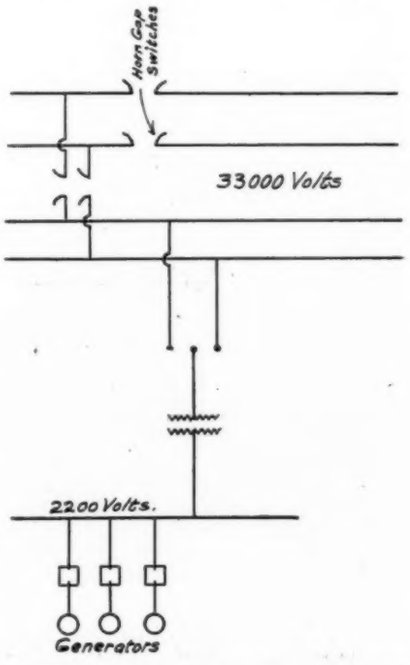


FIG. 3.—WIRING DIAGRAM OF MILL CREEK NO. 1.

volts working potential. The insulator, now known as the "Redlands type," is a porcelain insulator, the cross section of which (Fig. 2) accompanies this description.

The three-phase line delivered energy for both lighting and power, the latter being disposed of by a consumer known originally as the Union Ice Company. This company operated a 120-kilowatt, three-phase, synchronous motor for ice manufacture, and was located about four and one-half miles from the generating station. It is interesting to note that the Union Ice Company was at that time one of the largest dealers in

ice, in the West, and in consequence of the high price of coal, the ice company was induced to enter into a contract with the Redlands Company, which could furnish power sufficiently low to permit the ice company to ship ice to Los Angeles, where the high price of coal practically annihilated competition, even with a freight rate on ice of two dollars per ton.

The switchboard equipment of the Redlands plant was installed by the General Electric Company. The generator switches were of the 500-volt, triple-pole, double-throw type, which had previously been used in electric railway work, and was the best switch which the art could devise at that time. It was disastrous to open these switches under load, and on this account it was necessary to shut down the plant when a change-over was to be made.

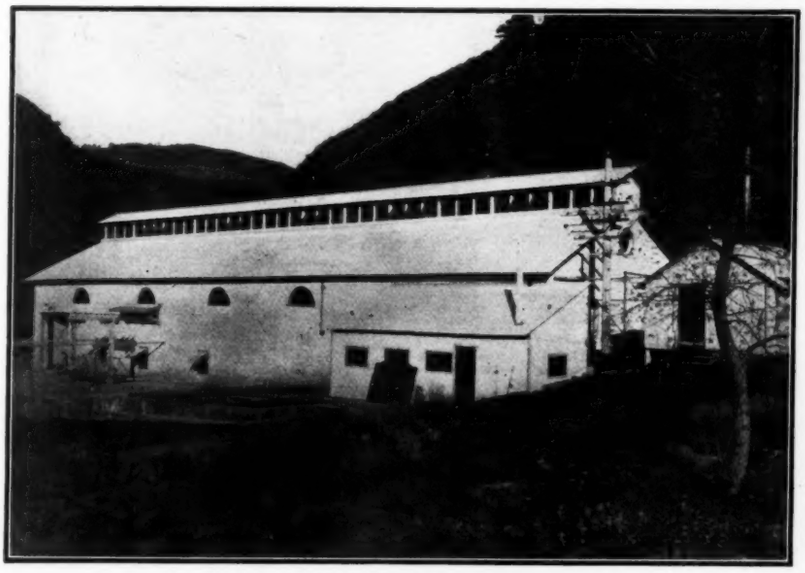


FIG. 4.—MILL CREEK NO. 2 AND NO. 3.

The construction of the switchboard consisted of a wooden frame-work composed of several uprights, to which horizontal strips were secured at distances corresponding to the width of instruments and switches. The instruments contained on this board were three ammeters and one voltmeter for each machine, a rheostat, and the double-throw switches formerly mentioned. The instruments were of the Thomson-Houston type, square in shape.

HYDRAULIC AND MECHANICAL FEATURES.

In making measurements of stream flow for the Redlands plant it was found that the minimum flow was 1,000 miner's inches, or 1,200 cubic feet per minute, or practically nine thousand gallons per minute. With a head of 295 feet this gives 670 theoretical horsepower, from which an estimate of 359 kilowatts was made as a practical working capacity. It was found that by extending the pipe line (as has since been done) the capacity of the plant could be doubled for the whole year, and three times the original capacity could be had for six months.

The machines originally installed were first intended to be belt-driven, but it was seen that direct-coupled units were superior, and this arrangement was adopted. There were two compound-wound exciters, each seven and one-half kilowatts capacity, independently driven by Pelton water-wheels, which ran at a speed of 1,600 revolutions per minute.

Governing was accomplished by a differential type of governor, quite common in connection with Pelton wheel installations of that period. The principle of action of this governor was based upon the operation of two elements: one at constant speed, and the other variable. The constant speed was supplied by the exciter shaft, as this was considered constant under normal conditions, from the fact that its load was practically constant. The variable speed was that of the main generator. When this would increase or decrease, the action of the governor would tend to correct the difference in speed between the two elements referred to.

One of the greatest obstacles with which Mr. Decker was confronted during the development of the Redlands system arose from the fact that the companies considering bids would not concede to a clause in the specifications which demanded that a machine was to operate in parallel with a similar machine. After the machines were installed, however, the attempt to parallel them naturally followed, and if the experiences could be related by the engineers then connected with the plant their statements would prove highly entertaining. At the outset no means was available to determine when synchronism was reached. Finally the General Electric Company produced a piece of apparatus known afterwards as a "growler," which consisted of two electromagnetic devices which corresponded to two separate phases of the line. The object was to cause vibration upon two sheet-iron diaphragms, which were supposed to reveal by their sounds when they were in unison. Due to certain higher harmonics this scheme failed, and other devices for synchronizing were later brought into practice.

EXTENSIONS OF REDLANDS PLANT.

In 1896 it became necessary, on account of the growth of the company, to extend its system to supply power for pumping service. The transmission lines were extended to Colton and Riverside, and three 100-kilowatt Wagner transformers were installed in the power station for raising the line potential to 10,000 volts. At this time the pipe line was extended 3,000 feet, increasing the head to 510 feet, equivalent to a hydrostatic pressure of 220 pounds per square inch. The total length of pipe line is now 10,250 feet, a large portion of which is of riveted steel, thirty inches in diameter.

Mill Creek No. 1 station has necessarily been undergoing changes, from time to time, in order to keep up with the progress of the art. The present installation consists of three three-phase generators of 250 kilowatts each, operating at 2,200 volts potential with a frequency of fifty cycles. These are connected to step-up transformers whose high-tension side feeds a 33,000-volt transmission line. There are two exciters, each of seventy-five kilowatts and 110 volts. The water-wheels are of the improved Pelton type, operating under a head of 510 feet, as before mentioned.

The transformer capacity is 800 kilowatts, consisting of two Westinghouse 150-kilowatt transformers, ratio 33,000-2,200 volts, and two Crocker-Wheeler, 250-kilowatt transformers, ratio 19,060-2,400, all single-phase. An elementary wiring diagram (Fig. 3) of the Mill Creek No. 1 plant is shown herewith.

MILL CREEK PLANT NO. 2 AND NO. 3.

In 1899 the growth of the business demanded a considerable amount of further development, and accordingly a new station known as Mill Creek No. 2 was begun. This plant is located above Mill Creek No. 1 plant, at a point such that the tail-race discharge enters the intake of Mill Creek No. 1 (the original Redlands plant). Mill Creek No. 3 has since become a part of No. 2, as they are under one roof, and constitute a single plant (Fig. 4).

This plant is located seventy-five miles from Los Angeles, and is supplied from a drainage area of approximately nineteen square miles. The head of water for No. 2 installation is 627 feet, while that of No. 3 has a head of 1,960 feet, which when the plant was built was the highest head recorded in connection with any existing plant. It is still in the front rank as a high-head plant, and will unquestionably remain so. It is interesting to note here that the hydraulic difficulties encountered in this development were so serious, due to the abrasive action of the water, that radical means were sought to remedy the destruction wrought during comparatively short periods of operation. It was noted before No. 3 plant was in regular service that disaster was inevitable if some device were not contrived to absorb the kinetic energy of the water.

At this time O. H. Ensign was in charge of the work, and to him is due the credit of solving this problem, as well as constructing a number of other plants which called for engineering skill based more upon originality and resourcefulness than upon technical knowledge alone.

The device for overcoming the erosion under the high head above referred to, consists of a "vortex absorber," a rigid fixture, which is so simple in its principle of operation that one becomes astonished in comparing the experiences which are often necessary to lead us to a very simple means of solution. This appliance is constructed in a manner not unlike the buckets of an impulse wheel. The jet, upon striking the projecting edge, is divided equally into two parts, each circling upon itself a sufficient number of times to cause complete dissipation of the energy, without the destructive effects of erosion.

Mill Creek No. 2 plant originally consisted of two revolving-field, 11,500-volt, three-phase generators, running at 375 revolutions per minute. These were put in operation in November, 1899, and have a record of years of constant and reliable service. The present plant, embracing No. 3 equipment (Fig. 5) comprises five generators, four of which are rated at 750 kilowatts, and one 250 kilowatts. These are 750-volt machines, and are connected to three-phase, air-blast transformers, having secondary potentials of 33,000 volts, Y. The transformer capacity is 3,000 kilowatts, consisting of four General Electric, fifty-cycle, three-phase transformers. The hydraulic features embrace 45,758 feet of water conductors, 28,603 feet belonging to No. 3, and 17,155 feet to No. 2 plant. No. 2 installation has five tunnels, and No. 3 has nineteen, of which 6,963 feet is for the latter, and 1,826 feet for No. 2. There are in all twenty-eight flumes, which have an aggregate length of 2,692 feet. The flumes for No. 2 installation have a cross-section two feet by 2.5 feet, and the dimensions of No. 3 are three feet by four feet.

The pressure pipe lines include 8,096 feet for No. 3 and 1,479 feet for No. 2. This comprises pipe diameters of 21.2 inches, and twenty-six inches in No. 3, and thirteen inches, and eighteen inches in No. 2. The velocity in No. 2 is 12.4 feet per second, and in No. 3 is 6.5 feet per second.

It is well to note in connection with high-head plants the importance of eliminating sand and silt before it reaches the pressure pipe lines. This is accomplished by a sand box, which is nothing more than a large settling basin, in this case constructed of concrete, and having a number of compartments through which the water passes before reaching the pressure pipe.

The sand box for No. 2 installation is fifty feet long, and twenty-two feet wide. It is divided into five compart-

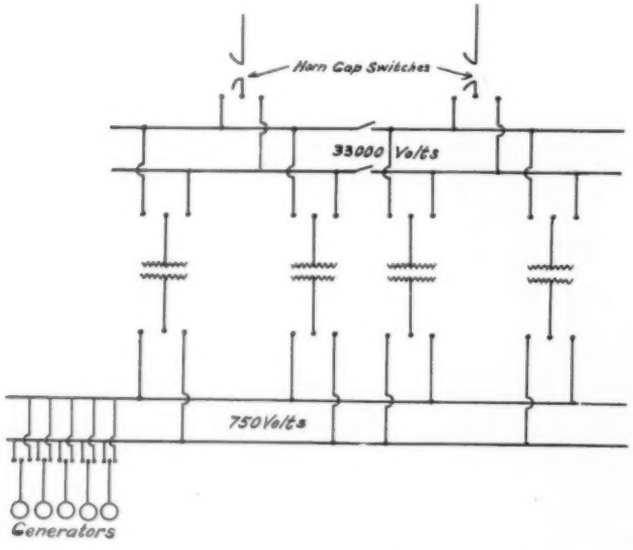


FIG. 5.—WIRING DIAGRAM OF MILL CREEK PLANTS NO. 2 AND NO. 3.

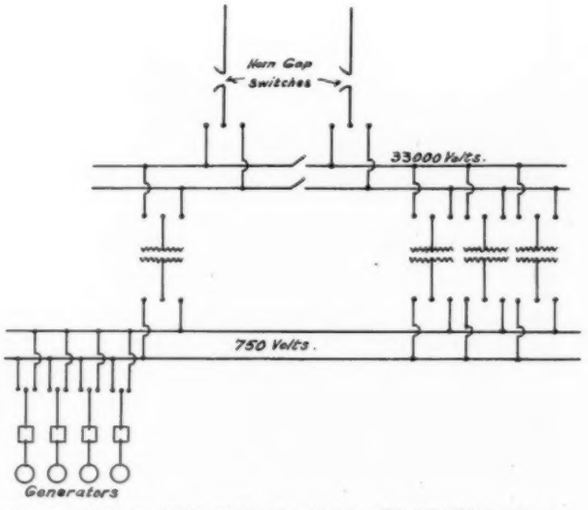


FIG. 6.—WIRING DIAGRAM OF SANTA ANA STATION NO. 1.

ments, by means of concrete walls. The depth on the upper side is five feet, and on the lower side, nine feet. The bottom of these compartments, in addition to sloping four feet in twenty-two, are V-shaped, so that the sand may be sluiced out, after collecting, below. A flume extends along the upper side, from which openings are constructed at points opposite each one of the compartments, in order to admit water to any compartment. Water is carried from one to the other over wide-crested weirs.

No. 3 installation has a sand box similar to No. 2, but of different dimensions, having eight chambers twelve and one-half feet wide by fifty feet long.

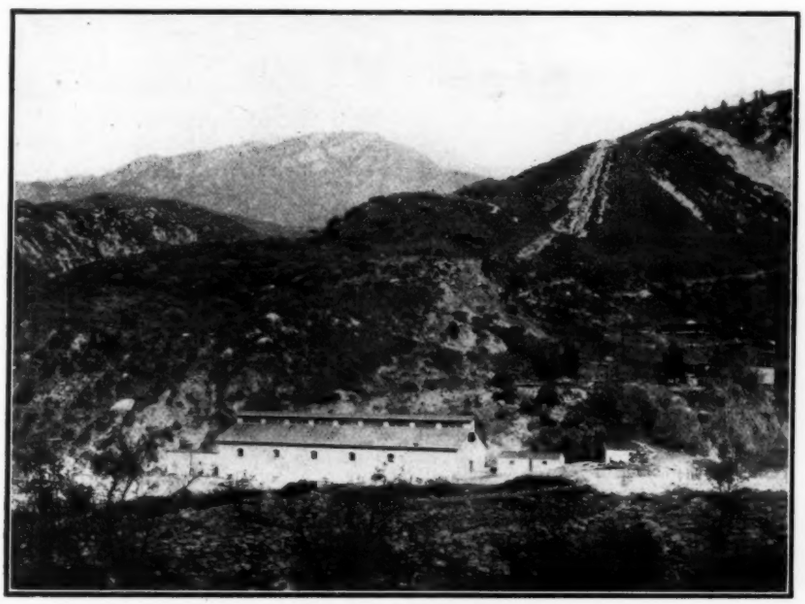


FIG. 7.—SANTA ANA POWER PLANT NO. 1.

The slope in each is four feet in fifty. The top of the dividing walls, with the exception of the middle wall, is three feet beneath the surface of the water. The middle wall projects above the water line, diverting the water around through a gate, instead of over the wall, as in the other compartments. In spite of the precautions taken, to rid the water system of sand and other sediment, it is impossible to avoid it entirely, and the nozzles show erosion, the seriousness of which varies with the nature of the water, and the head under which a plant operates.

It is of interest to those viewing the history of this organization to state that previous to the installations at Mill Creek, that is, in December, 1896, the people then composing the Redlands system organized a corporation known as the Southern California Power Company, which had water rights in the Santa Ana Canyon. After perfecting plans they entered into a contract, in 1897, to install apparatus which since has been placed in the Santa Ana plant, to be described.

In April, 1898, when this plant was but partially complete, the property of the Southern California Power Company was sold to the Edison Electric Company, now embraced in the Southern California Edison Company. The owners of the Southern California Power Company, at the time mentioned, were H. H. Sinclair and Henry Fisher.

The Santa Ana Canyon plant was completed in December, 1898, when water was first turned into the canal. At this time O. H. Ensign had direct supervision of all engineering work on this property, and the work in question, as well as that of earlier developments, gives Mr. Ensign a conspicuous place in the realm of high-tension transmission. The construction of this system was under the general management of H. H. Sinclair, whose name, and that of his associates, deserve praise for their work in promoting transmission development.

BEGINNINGS AT LOS ANGELES.

In the spring of 1895, E. E. Peck made application to the Common Council of the City of Los Angeles for a franchise for the purpose of installing and operating an electric lighting plant within the city limits. After considerable delay this franchise was advertised, but Mr. Peck was not successful in securing a claim to it. Persistent effort on his part, in the face of many discouraging experiences, finally won for him a franchise, permitting him to install and operate a plant in a territory southwest and adjoining Los Angeles. The plant was finally built, and consisted of a small frame building, in which they installed an eighty-horsepower Buckeye engine, an eighty-horsepower fire-tube boiler, and a thirty-light, eighteen-ampere arc-light machine. The company's first load comprised five commercial arc lamps and three street arcs, the latter being paid for by subscription from residents. This plant marked the beginning of the organization bearing the title of this article.

At the inception of the plant just described, it was realized that a large amount of capital would be needed to carry on further development. Therefore, a number of capitalists were sought who could bear the financial burden accompanying further extensions. A number of prominent men of Pasadena soon entered into an agreement to finance such extensions, and in December, 1895, a fifty-kilowatt Fort Wayne, 2,000-volt alternator, several Fort Wayne transformers, and Shellenberger meters were ordered.

In spite of Mr. Peck's repeated efforts to secure a franchise to extend lines into the city of Los Angeles, these efforts were futile. This fact notwithstanding, the transmission lines were finally brought into the city by setting poles on private property. Following this procedure, the lines were cut. They were again replaced, with the same result. After being cut and replaced a number of times, they were allowed to remain. Since no legal franchise had been granted, however, it became not only desirable, but necessary, to obtain one before confidence as to the future business could be established.

Other discouragements followed the renewed application for a franchise, until at last an old franchise, known as the Scott franchise, was purchased. A clause in this franchise demanded that the lighting company was compelled to supply current to the City Hall free of charge. The terms were such that only two weeks were allowed in which to extend lines to said building. As this

was a physical impossibility another plan was necessary. The method adopted was to use the poles of the existing traction company. It was through this means that energy was furnished to a small cluster of lamps, on the evening of the day before the franchise would be forfeited, had not said lighting been supplied.

Obstacles had not disappeared, for a controversy now arose as to the validity of the Scott franchise, and a suit was brought to annul it. Final settlement, however, favored the lighting plant, and the difficulties of this nature were at last ended.

On June 5, 1896, the West Side Lighting Company was incorporated, with a capitalization of $500,000. As soon as this organization was formed, a new location was sought, which would be

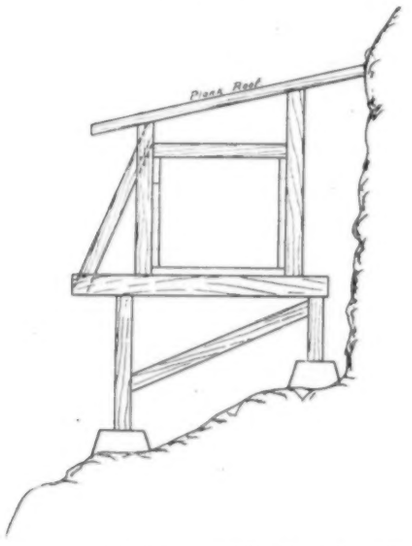


FIG. 8.—FLUME CONSTRUCTION TO PREVENT INJURY FROM LANDSLIDES.

more central. The next move was the purchase of an old cable power-house at the corner of Second and Boylston Streets, which, after vigorous work in changing over, was transformed into a central power station, and by December of the same year the company began operations. The equipment consisted of two ninety-horsepower Babcock & Wilcox boilers, a 150-horsepower Ideal engine, a Brownell open heater, and a seventy-five-kilowatt, 2,000-volt, Fort Wayne alternator, in addition to the old apparatus which was moved from the original plant. An energetic campaign for business followed, and the growth was so rapid that in January, 1897, an additional installation became necessary. This comprised two 200-horsepower Stirling boilers, one 175-horsepower Ideal engine, and one 120-kilowatt, 2,000-volt, General Electric alternator.

A short time afterward an additional equipment was installed to the extent of a 250-horsepower Ideal engine, two 120-kilowatt, 2,000-volt, General Electric alternators, and 150-horsepower Cochrane heater.

In February, 1897, the old low-tension arc generator was supplanted by a Western Electric eighty-light machine,

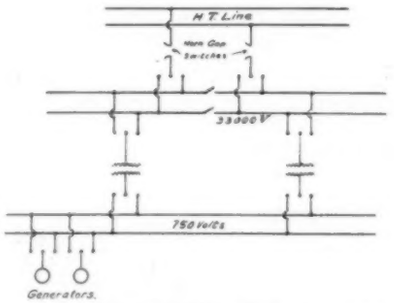


FIG. 9.—WIRING DIAGRAM, SANTA ANA STATION NO. 2.

and a Wood eighty-light machine. A little later these were reinforced by the addition of a 125-light Brush arc generator. In the fall of the same year the company began a power business, in accordance with which they installed two 100-kilowatt, 550-volt, direct-current Westinghouse machines. In December of the same year the West Side Lighting Company sold out to the Edison Electric Company, which, in July, 1894, was incorporated with a capital of $500,000. The Edison Electric Company retained the original board of directors of the West Side Lighting Company, and others were added. At about this time John B. Miller was elected treasurer of the Company, and he became an important factor in its financial workings. Mr. Miller was later made president of the Company, which office he holds in the present organization.

The epoch which marked the sale of power for industrial purposes was accompanied by the addition of a new Stirling boiler, a 500-horsepower condenser, and a 500-horsepower open heater. A 300-horsepower Ideal engine was next procured, to which was added a Westinghouse three-phase, 240-kilowatt generator, which had been used by the Southern California Power Company.

FURTHER HYDRAULIC DEVELOPMENT.

The system now began to assume larger dimensions, and another source of power was sought. In 1898 hydraulic development was completed, from which water was conveyed through a flume line to Santa Ana Power Plant No. 1 (Fig. 7). This hydraulic conduit begins at the junction of the Bear Creek and Santa Ana River. Two branch flumes are employed to divert the water, one conveying water from the Bear Creek, and the other from Santa Ana Canyon. At the junction of these conduits the water enters a tunnel, from which it is conveyed through a series of tunnels and flumes to the power house.

The drainage area contributing to the head waters of this plant is 180 square miles. The head under which the plant operates is 760 feet. There are at present three Peltons and one Doble waterwheel controlled by means of needle nozzles. The total rated generator capacity is 3,000 kilowatts, composed of four 750-kilowatt, 750-volt, three-phase General Electric generators (see wiring diagram, Fig. 6). There are three exciters. There are also six 500-kilowatt General Electric, oil-insulated, single-

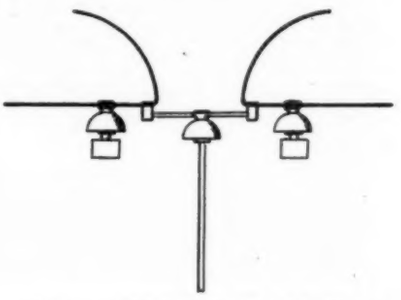


FIG. 10.—HORN-GAP LINE SWITCH. Used on 33,000-Volt Lines for Emergency.

phase transformers, which transform from 750 volts to a secondary line potential of 33,000 volts.

The building for this plant is 36½ feet by 126 feet. The plant was built by the Electrical Engineering Company under the personal supervision of B. F. Pearson. This plant is located sixty-eight miles from Los Angeles, and is in a wooded canyon which affords an unusually attractive environment.

The hydraulic construction is interesting, and is representative of California high-head plants. The waterways comprise nineteen tunnels, extending through various spurs, from the junction of Bear Creek and Santa Ana River to the head of the pressure pipe. Several flumes span the canyons be-

tween tunnels. These flumes are constructed of California redwood, as are most of the water conductors used for this purpose.

The tunnels are lined with concrete, making a net height of six and one-half feet, and a width of four and one-half feet. The capacity of these tunnels is 120 second feet, which is good for 6,000 horsepower. The sand box is constructed with two parallel hoppers having sluice gates at the bottom, through which the accumulated sand and silt can be discharged. The object of two hoppers is to discharge one while the other is serving its purpose, thus avoiding interruptions.

FLUME CONSTRUCTION.

Here, as in all similarly constructed hydraulic works, the wooden flumes are the weakest feature of the water conductors. This is mainly because the flume must be carried along the mountain sides, which are generally rugged and steep. Landslides of greater or less magnitude are almost certain to occur, and protection of the flume against these elements is a matter requiring careful consideration. Where a flume must pass over a rugged canyon in which loose rock is the chief formation, a method of protective covering shown in Fig. 8 is used, this construction rendering the flume immune from destructive effects of loose rocks and boulders of limited size. In a canyon which is thickly covered with vegetation such construction is generally unnecessary. While it is true that the landslide is a thing greatly to be dreaded, it is also true that there are other factors causing the stoppage of water, entirely or partially. One of these is the accumulation of leaves and sticks. In connection with Santa Ana No. 1 plant an ingenious device is employed for removing such debris. In the West this device is commonly termed a "grizzly." It consists of a screen or rack, usually placed on a slant and having a mechanical "agitator" which prevents leaves from sticking to the racks. It is actuated by the flow of water in the flume, which causes a gear and chain to drive a set of scrapers over the screen continuously. This apparatus, though automatic in its action, should undergo frequent inspection, in order to insure its proper working.

It is well worth noting, that the hydraulic plants are tied to the transmission system without the intervention of automatic switches. Even in the Kern River plant the oil switches are non-automatic. This practice may be considered as standard for a system of hydroelectric plants operating under similar conditions.

In Santa Ana Plant No. 1 there are two pressure pipe lines leading into the plant; these two pipes connect to a receiver or "hydraulic header," from which the individual nozzles receive their supply. In Plant No. 2 there are but two generating units (Fig. 9). These are fed from one pressure pipe.

Santa Ana No. 2 plant is located in Santa Ana Canyon, sixty-seven miles from Los Angeles. The building is 30 feet by 60 feet, and has a rectangular wing 16 feet by 22 feet on one side. This plant was finished April 15, 1905, and has been giving practically constant service since its completion. It contains two 500-kilowatt, three-phase General Electric generators, operating at 176 revolutions per minute at a potential of 750 volts. The generators are each driven by a Doble wheel, under a head of 304 feet. There are eighteen buckets on each wheel. The nozzle stream is seven and one-fourth inches in diameter. There are six air-blast transformers whose secondaries connect to the 33,000-volt transmission line. A striking feature of both Mill Creek No. 3 and the Santa Ana plants is to be seen in the fact that no oil switches are installed in these plants. The leads from each generator are brought to three separate knife-blade switches connected to the low-tension, 750-volt fuses. When putting a machine into service, one of these switches is closed first. Then the other two are closed simultaneously. The effect is the same as if three legs were thrown in at the same time.

Just outside the station (both at Mill Creek No. 2 and No. 3, and Santa Ana No. 1), where the lines drop to the first pole, a special line-disconnecting switch is used. This consists of a straight blade, made from the live wire, and connected at each end into a clip which is secured to the lower side of a horn. The sketch shown in Fig. 10 illustrates this. The switch blade, or piece of live wire, has an insulator fastened to it, and this hangs in a position which gives an opportunity to screw in a wooden stick from below. The wooden stick is kept dry by keeping it deposited in an iron pipe secured to the pole, just above a platform designed for the use of the operator. During an emergency in which it becomes necessary to ascend and open the horn gaps, the operator may climb upon the platform and manipulate the switch blades in safety.

(To be continued.)

Three Hundredth Meeting of the New York Electrical Society.

The three hundredth meeting of the New York Electrical Society was a notable gathering. It was held at the Hispanic Society Building, One Hundred and Fifty-seventh Street, near Broadway, which contains the wonderful Museum of Hispanic Antiquities, collected and donated by Archer M. Huntington, who is a life member of the Society. The library, supplementing the museum, contains 75,000 volumes. The Society is to be congratulated on securing such fitting and congenial surroundings for the giving of F. O. Blackwell's lecture on "Hydroelectric Development in Mexico." Mr. Blackwell prefaced his lecture with a most interesting summary of the factors which have contributed to the present conditions in Mexico, and showed how the great water powers of the country have been made possible only by the encouragement of President Diaz.

Before the lecture there was a short business meeting. The reports of the various committees showed that the Society has entered on a new era of activity and prosperity. Twenty-five members and thirty-two life members were elected, and the treasurer reported that the heavy debt of the Society had been wiped out, and the finances were now in good condition.

The next "visiting" meeting, early in May, will be a memorable function. The members have been invited by Thomas A. Edison to visit the laboratory at Llewellyn Park. They will be taken by a special train, having luncheon on their arrival. A reception will then be given by Mr. Edison, after which a paper will be read on "The Applications of the Edison Storage Battery." The members will then inspect the laboratory, where every part of the battery will be seen in course of construction. Before the return of the special, there will be an exhibition of moving pictures made in the laboratory.

Minnesota Electrical Association.

The fourth annual convention of the Minnesota Electrical Association was held in St. Paul, Minn., March 14, 15 and 16. Headquarters were established in the St. Paul Hotel. A report of the opening session on Tuesday morning appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for March 18.

AFTERNOON SESSION.

The first order of business at the afternoon session was a paper entitled "Safety in Line Construction," which was read by H. G. Winsor.

SAFETY IN LINE CONSTRUCTION.

This paper deals mainly with pole-line distributing system rather than high-tension system and contains a vast amount of data relative to material and methods employed in Minneapolis. The first phase of the subject considered was the "lay-out." The author said that in laying out a pole line care should be exercised in avoiding trees and the lines of other companies. Feeding points of feeders should be located as near the center of gravity as possible after considering future requirements. Intersections with telephone, telegraph and electric railway lines should be carefully planned and the equipment designed to avoid contact with the same. Lightning arresters should be so placed as to protect station and substation apparatus, underground cables and line transformers. In providing lightning arresters Mr. Winsor said the ordinary multigap arrester seems to give good service, but cannot be depended upon to discharge continuously for considerable period as in the case of accidental grounds. He added that it is also considered good practice to require grounding of all alternating-current secondaries carrying a potential of 150 volts or less.

Mr. Winsor next considered the material to use and in this connection gave detailed descriptions of the poles, cross arms, braces, guy equipment, insulators, pins and wire used in Minneapolis.

Methods of application were next considered. Among the important points brought out under this heading were that poles should be set to a depth of one-seventh of their length; double arms should be placed at all junction points at intersections and at line-terminal poles; in making up a guy the strain insulator should be carefully placed; clamps with double bolts should be used in all cases where strand is to be fastened or joined; in erecting transformers no more than one should be placed on a pole unless special provision is made; and lightning arresters should be installed on each leg of all primary circuits. In conclusion Mr. Winsor advocated the periodic inspection of all pole lines.

In reply to a question asked by F. R. Cutcheon, of St. Paul, as to whether or not a regular inspection is made in Minneapolis, Mr. Winsor said that one man is permanently detailed for this work and he is assisted whenever necessary. He added that it is advisable in smaller stations to have the arc-lamp trimmer report any line trouble.

The next paper to be presented was by T. R. Willwerscheid, of St. Paul, entitled "Window and Sign Lighting." This paper contained a number of excellent suggestions on outline and show-case lighting as well as the branches covered in the title.

WINDOW AND SIGN LIGHTING.

This paper dealt with the four principal methods of electric advertising, namely, show-case lighting, display window lighting, outline lighting and sign lighting. Under the first topic the author spoke of the lack of development and the great field available. He called attention to the great development made possible by the introduction of low-watt tungsten-filament lamps and urged that central stations develop this field.

Under display window lighting the author said that this phase of advertising has been highly developed as a result of activity on the part of the central station. He advocated a flat rate for this class of business, the central station to have charge of renewals, turning on and off current, etc.

Mr. Willwerscheid said that outline lighting has been greatly neglected by central stations and no effort has been made to convince prospective customers that the cost of such advertising was not prohibitive. He said that a great field was available and should be developed by the central station.

In regard to electric signs the author described a number of installations, enumerated the points concerning which central-station solicitors should familiarize themselves and spoke at some length on the various types of signs available, and the best type of sign for particular installations.

In concluding Mr. Willwerscheid said that in addition to the current-consuming features of the devices, each one advertises light for the central station.

H. J. Gille, of Minneapolis, opened the discussion. He said that until recently show-case lighting was impossible on account of the prevailing types of construction. With the newer types which central stations have succeeded in having introduced, development can be expected in this line. Outline lighting has made very slow progress until recently on account of the high cost of current when using carbon-filament lamps. The tungsten sign lamp has done much to increase this business, however, as is the case with the electric-sign business.

H. E. Griffin, of Chicago, spoke briefly of the missionary work it is possible for traveling men to do, and in this connection cited an instance where a suggestion from a stranger led to ordering an electric sign.

In reply to a question as to the smallest-size lamp available, Mr. Willwerscheid said that the 2.5-watt lamp was the smallest so far developed.

J. B. Crane, of Duluth, spoke of the objection of projecting signs in connection with ornamental street-lighting installations.

Ludwig Kemper, of Albert Lea, advocated that central stations control the sale and installation of electric signs, and in this way they could install them so as not to interfere with existing signs or street-lighting installations.

Mr. Kingsley spoke of the advantage of the 2.5-watt lamp, it being possible, by using them, to place more lamps on a sign and thus make the sign conform more closely to the correct outlines of the letters.

The concluding paper of the afternoon session was entitled "Testing Wattmeters" and was presented by its author, F. R. Cutcheon, of St. Paul.

TESTING WATTMETERS.

This paper described very briefly the methods in vogue in St. Paul. Mr. Cutcheon stated that the testing of meters on the customers' premises was superseding the practice of testing in shops. In the future the only meters to be tested in the shop will be new meters and meters which cannot be tested on the premises. The former should also be tested on the customers' premises immediately after installation.

The author said where it is desired to demonstrate to a customer the accuracy of his meter the old-time lamp-bank test should be resorted to. Testing outfits should be so light as to be carried conveniently by one man. For testing alternating-current meters the phantom-load method was advocated, it being claimed that for meters up to 150 amperes in size no appreciable loss can be detected. For testing large direct-current meters Mr. Cutcheon advocated portable storage batteries or low-voltage generators. The rotating-standard test meter should be checked daily with the laboratory standards. Polyphase meters for polyphase motors can be tested as single-phase meters by connecting the field coils in series. Clock meters and theft of current were also briefly treated, and in conclusion a report was read showing that in a general meter test in St. Paul in 1910 eighty-six per cent were found to be reasonably accurate.

A brief discussion ensued after the reading of the paper, which was participated in by Ludwig Kemper and J. B. Crane.

WEDNESDAY MORNING SESSION.

The first paper presented at the Wednesday morning session was entitled "Day Load for Central Stations," and was read by the author, E. T. Street, of the Northern Heating & Electric Company, St. Paul.

DAY LOAD FOR CENTRAL STATIONS.

This paper opens with an outline of an equitable rate schedule, adaptable to any central station, which the author claims is the first requirement to obtain a day load. Of equal importance with the rate schedule is the education of the public and this paper points out how central-station companies can secure the co-operation of manufacturers in carrying on educational campaigns.

A number of different classes of business were then enumerated as being ideal for central-station day loads. The first mention was city pumping. With a properly designed system, pumping can be used to fill any valley in the daily load curve and can be profitably taken at a very low rate. An induction motor direct-connected to a centrifugal pump is an ideal pumping unit for many classes of service, and its simplicity and reliability will greatly aid central-station men in obtaining this class of business. Mechanical refrigeration was also

mentioned as a field for a profitable day load. The paper states that under ordinary conditions twenty-seven kilowatt-hours are required to produce one ton of refrigeration. This will have the cooling effect caused by the melting of one ton of ice in twenty-four hours. This amount of current at five cents per kilowatt-hour will cost $1.35, which is well below the cost of ice per ton to the ordinary consumer, while the rate of five cents per kilowatt-hour is not very low for this class of service. In addition to being cheaper than ice, mechanical refrigeration is so much more cleanly and convenient that an intelligent comparison between the two systems must result in favor of the latter.

Woodworking plants were referred to as being profitable loads if approached in the proper manner. The power requirements of the various machines and tools employed were mentioned and arguments for the power solicitor pointed out. Grain elevators are desirable business, not so much on account of steady operation, but because the heaviest load comes in the off-peak months. Mechanical drive in an elevator

GROUP AT MINNESOTA ELECTRICAL ASSOCIATION'S CONVENTION.

requires a very wasteful transmission of power to the top of the building for leg drive. Also the other machinery is usually scattered to such an extent that mechanical drive is very inefficient and complicated. In contrast with this, the central station can offer a remarkably simple equipment that can be entirely controlled from any one point desired.

Electric irons, stoves and various other household current-consuming devices were mentioned and in conclusion the author considers a typical central station, of 200-kilowatt generating capacity, presenting figures to show the amount of day load necessary to justify a day circuit.

J. B. Crane, of Duluth, opened the discussion, pointing out that the rate advocated by Mr. Street was very easily understood by central-station men, but would prove difficult to explain to the average customer. He said that this should be seriously considered in establishing any new system of rates. He said further that the rate did not take care of customers below ten per cent load factor or over fifty per cent load factor. Regarding woodworking plants as prospective central-station customers, Mr. Crane said that an argument successfully used by power solicitors in Duluth is that the refuse which is ordinarily used for fuel can be sold for a rate sufficiently high to insure a profit after purchasing current. Referring to electric drills, Mr. Crane mentioned a number of successful installations of this apparatus in Duluth and said that it was a profitable field for central stations.

Ludwig Kemper, of Albert Lea, took exception to Mr. Street's figures regarding refrigeration, in which it was stated that one tone of refrigeration could be manufactured at a current consumption of twenty-seven kilowatt-hours. His experience has been that the current consumption averaged between 40 and 50 kilowatt-hours.

J. D. A. Cross, of Chicago, spoke of household current-consuming devices and how electric flat irons have been instrumental in establishing a day load for central-station companies. He cited an experiment where a number of irons were placed on trial and the central-station company inaugurated a Tuesday morning service for the benefit of housewives who desired to employ these irons. This innovation proved so successful that other current-consuming devices were introduced and a permanent day load established.

The next paper presented was entitled "Residence Lighting," and owing to the absence of C. E. Van Bergen of Duluth, Mr. Higgins read this paper.

RESIDENCE LIGHTING.

Mr. Vanbergen in introducing his paper stated that his company was the first concern in Minnesota to enter into the residential lighting field, and added a brief résumé of the early lighting conditions in Duluth. At present there are in that city about 14,000 houses and of these 12,000 are wired for electricity. It is a significant fact that there are only 10,000 houses connected for water service and 7,100 are taking gas at seventy-five cents per thousand. The importance of continual watchfulness on the part of the central stations to see that newly constructed buildings were wired was especially mentioned. Each new house in up-to-date cities should have provision made for a heating circuit on which may be used a luminous radiator, electric iron or vacuum cleaner. The better class of residences should be wired for both a light and heating meter, at present nearly every medium sized residence in Duluth and many of the smaller ones being so wired. On the heating meter may be used electric range, portable radiator, electric grate, vacuum cleaner and electric irons. Mr. Vanbergen's company makes a rate of three cents per kilowatt-hour, less twenty per cent, with a minimum charge of $1.00 net per month on all current used through the heating meter. During the past year nearly a dozen electric ranges have been installed, besides a great number of electric grates and radiators, notwithstanding the fact that the gas rate in Duluth is low.

J. H. Gille, of Minneapolis, opened the discussion, pointing out that residence lighting offers the best source of revenue for the central station. He quoted statistics which showed that only twelve per cent of all the residences in the United States used electric light. He explained in detail the residence-lighting campaign which is being carried on by the Minneapolis General Electric Company of Minneapolis, and distributed samples of the literature which is being sent out in this connection. Speaking of the Minnesota State Fair, Mr. Gille advocated the establishment of a temporary electrical building until such time as the state legislature sees fit to appropriate money for a permanent electrical building. He urged that all members of the Association, individually and collectively, use their efforts to have such a building established.

Brief remarks were also made by Mr. Peterson, who explained the methods he used in encouraging residence business. In many houses in which improper wiring and fixtures are already in use the fixtures are in these cases

taken out, remodeled according to the most modern practice and then installed in the house so as to produce the best illumination.

"Incandescent Lamp Improvements" by Henry Schroeder of the General Electric Company, Harrison, N. J., was the next paper presented.

INCANDESCENT LAMP IMPROVEMENTS.

A considerable portion of this paper is devoted to a comprehensive historical résumé of the incandescent lamp. The origin and development of the carbon-filament tantalum and tungsten-filament lamps are fully treated and the methods of manufacture described. The characteristics of the various lamps were explained and their suitability for various service mentioned.

Regarding recent developments the author states that in order to make Mazda lamps in relatively low candlepower units, such as are required for sign lighting, a low-voltage lamp was designed to operate on one-tenth the voltage of the standard lighting circuits. These lamps can be burned either ten in series on direct current of 100 to 125 volts or in multiple on alternating-current circuits, using a transformer or compensator having a ten to one ratio. Over half a million of these lamps were used in the United States during the past year and they have opened to the central station a means of obtaining sign-lighting business which has heretofore been impossible on account of the high cost for the current consumed.

The introduction of the tungsten-filament street-series lamp has almost entirely displaced the carbon lamp and the gem series lamp for this service. Mazda series lamps having a comparatively thick filament, are strong and rugged and give excellent life results. They can be made equally well in low or high-candlepower units, being at present regularly produced in from 32 to 350 candlepowers. They also have an advantage over other types of series incandescent lamps in that they can be burned in the higher amperage ranges of arc lamp circuits with entire satisfaction.

Practically all the battery types of lamps, with the exception of telephone lamps, are now made in tungsten filaments, as the high efficiency of the tungsten filament is of great value on battery circuits where the cost of energy is high.

As there are over ten thousand different kinds of incandescent lamps (and this does not take into consideration the fact that each kind of incandescent lamp is made in different voltages), it becomes necessary that a definite classification be made. Incandescent lamps are, therefore, divided into three distinct styles depending upon the kind of base.

In reply to numerous questions as to the developments which can be looked for in the near future, the trend of developments as to future sizes of lamps and the comparative life of frosted and clear bulb lamps, Mr. Schroeder said that the drawn-wire lamp which the General Electric Company has experimented with for some time is now ready for distribution and in this lamp the mechanical life is increased four times. Regarding sizes, Mr. Schroeder said that lamps were available as small as 2.5 watts, but that the 5-watt sign lamp was the most popular for small work and the 25, 40, 60 and 100 watts for general lighting. In reply to a question as to why larger lamps burned longer than the smaller, Mr. Schroeder said that this probably is due to the fact that in the twenty-five-watt lamp there is about twenty-five square inches of glass or one square inch per watt, while in the 500-watt lamp there are four watts per square inch which, of course, tends to increase the temperature and shortens the life of the lamp. He then spoke briefly about the 350-candlepower series lamp which is now available for street lighting and is claimed to give service as good as the 6.6 ampere street-series arc lamp.

On Wednesday afternoon the delegates were taken on an extended sightseeing trip which included an inspection tour of the electric plants of the Northern Heating & Electric Company, and the St. Paul Gas Light Company. The trip also included a visit to the St. Paul Gas Light Company's sandrock tunnels which underly a greater part of the upper business district some sixty or seventy feet below the street surface.

THURSDAY MORNING SESSION.

The session of Thursday morning was opened with a paper on Gas Producer Engines for Central Stations by A. W. Wagner, manager Huron Light & Power Company, Huron, S. D. Owing to the absence of the author, this paper was read by E. T. Street.

GAS PRODUCER ENGINES FOR CENTRAL STATIONS.

The most of Mr. Wagner's remarks were drawn from his experience and the records of the Huron Light & Power Company at Huron, S. D. In that plant there is one 300-horsepower Muenzel gas engine belted to a 200-kilowatt 2,300-volt Ft. Wayne alternator and one 100-horsepower Muenzel gas engine belted to a 100-kilowatt, 2,300-volt alternator, both machines operating at sixty cycles. The paper called attention to the arrangement of the Huron plant and dwelt especially on the necessity of seeing that engine foundations of a new plant were solid, that the piping was properly done and the exhaust taken care of without creating an unnecessarily high back pressure. Quality of coal is, of course, an important factor, although investigations by the United States Geological Survey Department on the actual operation of plants show very good results from bituminous coal and even lignites. They require, of course, special producers and scrubbers, as there are more impurities (especially tar) in these coals. However, local conditions, as to cost of coal delivered and cost of handling, should determine which style of producer should be installed to obtain the best economy.

While the cost of installation is in general given as more than that of a steam-driven plant of the same capacity, the cost of generation is much lower, and in other points the gas-producer plants compare very favorably with steam plants. The reliability depends upon the construction and attention in operation, and the author stated in closing that he did not think it is exaggerating to say that with the proper attention, a properly installed gas producer plant is almost as reliable as a steam plant.

Due to the fact that the meeting started later than the hour scheduled and that the author was not present there was no discussion. The next paper, entitled "Insurance," was next presented by R. L. Daniel, of Minneapolis, the author.

INSURANCE.

This paper contains a number of reports that emphasize the great fire loss in this country. From these it is shown that the fire loss in the United States for a period of five years ending in 1907 was $3.02 per capita as compared with $0.33 per capita in six of the leading European countries.

The author states that one of the greatest services rendered by the insurance companies is that of inducing the insured to improve his risk in any way that will reduce the fire hazard and possibly prevent a fire. The chief influence which the insurance companies can bring to bear for improvements is the fact that the better the risk from standpoint of fire hazard the lower will be cost of insurance. The result is that the assured by making proper improvements in his risk can not only reduce the immediate cost of his own insurance, but by the precautions thus taken to prevent fire he is also doing his share to keep down the loss ratio, and thus help to reduce the average rate. The average rate can only be controlled by the loss ratio, which is the percentage of premiums collected that is returned to pay losses—i. e., ratio of losses to premiums.

The system used in determining the risk on an electric plant was briefly described. This system starts with a basis rate of thirty-five cents per $100 insurance for the standard plant which imposes a number of conditions.

A valuation is then made for a plant which does not conform to these conditions and the rate increases to $3.10. The author considered a number of the more important questions and made recommendations which would materially reduce the risk if complied with.

In reply to a question as to whether or not there was any difference in the rate charged for approved gasoline installation and approved electrical installation Mr. Daniel said that gasoline installations usually were charged a higher amount due to the fact that very few installations could be made according to the code.

E. F. Strong, of Chaska, asked Mr. Daniel what the difference in the rate would be of a plant changing over from gasoline-engine to motor drive. Mr. Daniel said that there would be a material reduction where motor drive was employed although where the change was made to direct-current motors the rate would not be as low as where the induction motor is used. This is due to the direct-current motor having exposed commutator and

brushes; if inclosed construction was available this risk would be overcome.

The discussion was closed by Mr. Zimmerman who spoke of the discrepencies in insurance rates, citing instances where a gasoline installation received a lower rate than premises where an electrical installation was made.

"Engine and Boiler-room Records for Plants up to 250-Kilowatts Capacity," was the title of the next paper presented by E. Holecomb, manager Northern Heating & Electric Company, St. Paul.

In lieu of reading a paper Mr. Holcomb exhibited a number of typical charts and records which he had collected from central-station companies throughout the country. These charts were explained and commented upon by the speaker. There was no discussion of this paper.

The report of the nominating committee, which was appointed at the opening session, was the next order of business taken up. The recommendations of the committee were unanimously approved and the following officers duly elected: president, Ludwig Kemper, manager Albert Lea Light & Power Company; first vice-president, C. E. Van Bergen, manager Duluth Edison Company; second vice-president, E. A. Aspnes, Montevideo; and secretary-treasurer, E. T. Street, Northern Heating & Electric Company. The new directors named were Messrs. Leonard, Marvin and Markle.

After brief remarks by the newly elected officers the paper entitled "Gasoline Competition," by Ward Harrison and H. H. Magdsick was presented by the former.

GASOLINE COMPETITION.

This paper describes at some length the various gasoline systems in use, pointing out their advantages, their disadvantages and how they are rated by the insurance companies. Complete cost data are given and comparisons made with electric systems.

But putting aside all questions of attendance, inconvenience, and danger, and granting that if a merchant places no value on his time, the direct expense of lighting a store with gasoline is less than with electricity, we are still far from the conclusion that gasoline lighting is really more profitable to the consumer. The efficiency of a commercial lighting installation is not to be measured solely in candlepower hours per dollar. The real purpose of such an installation is to make possible and to increase the sale of goods after nightfall and its efficacy must be measured by this standard. The system which costs most to operate will often yield the greatest margin of profit. If this were not true electric light would never be used in natural gas territory. Electric lamps burn silently, without fumes or smoke, and with practically no heat. The existence of a well-designed installation of tungsten-filament lamps is one indication that its owner is a progressive business man. Such an installation cannot fail to have a decidedly favorable influence upon the mind of a prospective customer. A gasoline equipment may be capable of economically lighting a building but the electric illumination of stores and show windows is an advertising proposition that pays.

In conclusion there are mentioned a number of books treating on the evils of gasoline which the author recommended for central-station use in fighting gasoline competition.

Thomas Pitts, of Hutchinson, spoke briefly of his experience with the literature mentioned in Mr. Harrison's paper and recommended the bulletins of the National Electric Light Association as the most impressive from a central-station standpoint.

LUDWIG KEMPER,
President-elect Minnesota Electrical Association.

The paper and practical demonstration of Prof. George D. Shepardson, of the University of Minnesota, on "The Elementary Theory of Alternating-Current Motors," which was carried over until the last session on account of the enforced absence of Professor Shepardson, was then presented by Professor Ryan.

This paper explains the performance of the most common types of alternating-current motors as modified direct-current motors. The operation of an electric motor, whether direct or alternating current, may be explained by a few comparatively simple laws and in the treatment of this subject Professor Shepardson limited his discussion to on analysis of these laws and their relation to one another. The first law is that of the magnetic field; the second, that of induction; the third, that of magnetic pull or torque; the fourth is a modified form of Ohm's law, namely that the current is directly proportional to the applied electromotive force and is inversely proportional to the impedance; the fifth law is that of the combination and resolution of forces. The discussion was illustrated by charts and a working exhibit.

At the conclusion of this demonstration W. R. Ferris, of Ferris Brothers, spoke briefly on the subject of "Central-Station Accounting." He pointed out that accounting was one of the most important phases of central-station business. He said that until central-station companies adopt a uniform system of accounting and are able to compare the statistics of one with the statistics of another in terms of per cent, there is a great field for development. He made a number of pertinent suggestions for uniform methods of accounting and explained methods he employs. The general account is divided into four main heads, namely liability, assets, receipts and expenses, and these in turn can be divided into any number of sub-divisions. Mr. Ferris spoke of the value of accounting in the establishment of an equitable rate system, and in establishing credit. He exhibited a number of records adopted for use and said that the company he represents carries fifty-two records and the cost of this system does not exceed $60.00 per month.

MANUFACTURERS' REPRESENTATIVES.

The Fort Wayne Electric Works, General Electric Company, Bryan-Marsh Company, and Northwestern Electrical Equipment Company were the only firms maintaining exhibits, although the manufacturers and supply men included the following:

Bryan-Marsh Company, J. S. Barnard, J. H. Phelps, W. A. DeForrest, J. F. Chamberlain; Central Electric Company, Chicago, D. C. Penniman, E. S. LaClaire; Electric Appliance Company, C. C. Simpson; Electric Engineering Company, W. F. Stephenson, M. Holden, D. P. Ensign; Evans-Almirall Company, F. H. Stevens; Fort Wayne Electric Works, G. R. Scott, A. H. Savage, M. B. Beattie; General Electric Company, Fred T. Benson, J. S. Buchanan, J. D. A. Cross, W. F. Smith, S. F. Dibble, Henry Schroeder, A. S. McMullen, G. G. Fletcher, G. B. Wallser, C. J. Strayer, W. H. Colman; George J. Cadwell & Company, Minneapolis, George J. Cadwell; Hawks Power Company, B. S. Hawks; Holophane Company, Morgan P. Ellis; National Carbon Company, C. W. Wilkins; Northwestern Electrical Equipment Company, Robert P. Payne, A. M. Baldwin, Harold Wyatt, Jule Hanniford, A. J. Anderson; Northwestern Fuel Company, St. Paul, G. N. Hitchinson; Page & Hill Company, Minneapolis, S. S. Hill; Saint Paul Electric Company, B. B. Downs, A. R. Reinburger, V. W. Eaton, E. R. Smith, P. E. Simans; Wagner Electric Manufacturing Company, H. E. Griffin; Western Electric Company, H. C. Bentz, J. P. Carson, Jr., Paul F. Raney, Paul E. Davenport, Geo. E. Brown, J. P. Vinson; Westinghouse Company, Geo. F. Darling, C. C. Curry.

RAILWAY MEN MEET IN CHICAGO.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

The twelfth annual convention of the American Railway Engineering and Maintenance of Way Association was held in the Congress Hotel, Chicago, Ill., March 21, 22 and 23. The work of this Association, which covers practically every branch of railway engineering, is carried on entirely by committees and the program for the convention, therefore, included only the reports of standing and special committees.

Of interest to electrical men is the report of the committee on electricity, the report of which is contained in two bulletins, Nos. 127 and 130. The former contains the preliminary report of the committee on the subject of transmission line crossings. In bulletin 130 the committee gives a résumé of previous work and outlines the reasons for the appointment of the committee. As a matter of information, a comprehensive bibliography of published articles on electrification is included.

RAILWAY SIGNAL ASSOCIATION.

The spring meeting of the Railway Signal Association was held in Chicago, Ill., March 20, with a large attendance on hand. The meeting was called to order promptly at 10 a. m. by Pres. C. E. Denny and the committee reports promptly taken up.

The preliminary report of Committee No. 1, on signal symbols, was the first considered. In the absence of the chairman this report was presented by J. C. Mock. Mr. Mock stated in connection with the reading of the report that the standards, as presented, were substantially as submitted by the manufacturers and approved by the subcommittee. The report comprises reproductions and explanations of the various symbols most commonly met, with recommendations for changes and substitutions as deemed necessary. Arbitrary features have been avoided and very few radical changes made. After a brief discussion the report was adopted.

Committee No. 2, on Mechanical Interlocking, through its chairman, C. J. Kelloway, reported progress. After instructions covering the future work of this committee, a brief discussion ensued in which it was recommended that the committee should in the future recommend how to do a thing after it was decided what apparatus was to be installed.

At the opening of the afternoon session Committee No. 3 on Power Interlocking, through its chairman, B. H. Mann, reported progress and invited suggestions from members either on the floor or by correspondence. This committee is divided into eight subcommittees each of which reported progress.

The report of the Committee on Electric Signaling for Electric Railways was read by H. S. Balliet, chairman. This committee submitted a progress report of detailed specifications which included specifications for electric motor signals; alternating-current line-circuit and track-circuit relays; alternating-current supply for operating signals, track-circuits, line-circuit relays and indicators; circuit-breakers for moveable-point frogs, switches or derails, lever and latch circuit-breakers, drawbridge circuit-breakers and special circuit breakers; bonding materials, including copper, galvanized-iron and copper-clad bond wires, tinned, copper, and copper-plated channel pins, and impedance bonds; electrical conductors including rubber-covered wire, line wire and cables for low voltage circuits, and line wire and cables for high-tension circuits; wire conduits, including wood trunking, vitrified clay, fiber and iron; insulations, including rail joints and fiber and switch-rod, pipe-line and tie-plate insulations; and transformers and gird resistance shelters.

After disposing of the various committee reports a paper by A. H. McKeen on "Portable Storage Batteries as Applied to Automatic Signal on the Harriman Lines," was taken up and discussed.

STORAGE BATTERIES FOR RAILWAY SIGNALING.

This paper reviews, briefly, the conditions that obtained up until the present time on the Harriman lines. Gravity batteries were used for the line and track circuits, although later on the gravity line batteries were dispensed with and the storage battery served the double purpose of operating both line and motor circuits. The main lines of the Southern Pacific from Portland, Ore., to El Paso, Tex., and the Sunset Lines from El Paso to New Orleans, a total of 3,226 miles, are protected with automatic signals for a distance of 1,938 miles, and it is calculated that the remaining 1,288 miles will be completely signaled within two years. The total mileage of road protected by automatic signals on the entire system, on December 31, 1910, was 4,719 miles of single track, and 703 miles of double track, or a total of 6,125 miles of track so protected. On this mileage there are 12,050 automatic signal blades, practically all of which are operated by portable storage battery. There are in all 9,026 battery locations with a total of 48,516 type SS-7 cells in service, of which 12,412 cells, or twenty-five per cent, are extra cells used for charging. The methods of transportation were described. Some are transported in baggage cars of passenger trains, some in special battery cars of freight trains. Another arrangement consists of a charging plant built in a box car which is moved on the daily freight and set out at each alternate station. The methods of caring for the batteries, cleaning, assembling and inspecting, were fully described, also the application of the battery to the signaling mechanism. Some figures presented on cost showed that the cost of the storage battery installation on this system is $314,010.84, as compared with $893,586 for cost of primary cells and a maintenance cost of $74,763.02 per year for the storage battery as compared with $235,652.90 per year for the primary installation.

A brief discussion followed which was participated in by A. G. Shaver, E. E. Hudson and G. H. Dryden.

Mr. Hudson took exception to a number of figures presented by Mr. McKeen. Revised figures presented by Mr. Hudson made the maintenance cost per year for the primary batteries $110,971.66 as compared with $150,648.12 for the storage battery and cost of installation, $351,943.16 for the primary as compared with Mr. McKeen's figures.

A paper entitled "Principles Governing the Selection of Alternating-Current Signaling Apparatus for Railroads," by Frederick Howard was then presented. This paper stated the principles which call for attention in the selection of alternating-current signaling apparatus and discussed their bearing on the system embodying such apparatus. Both electric and steam roads were considered. Among the important subjects considered were inductive bonds, track relays, transformers and signal motors.

It was decided to hold the annual convention of the association in October, at Colorado Springs, Colo. The meeting then adjourned.

In the evening the members assembled in the rooms of the Western Society of Engineers at the invitation of the officers of the Electric Storage Battery Company and listened to a paper on "Storage Batteries, Their Manufacture and Their Care," by H. M. Beck. The paper considered chiefly the "Tudor" and "Iron-Clad"

positive plates, the use of jelly for electrolyte, and the charging and care of batteries. After the close of the meeting supper was served in a neighboring restaurant.

RAILWAY APPLIANCES ASSOCIATION.

In connection with the conventions of the Railway Signal Association and the American Railway Engineering and Maintenance of Way Association, reported above, there is being held in the Coliseum, Chicago, during the week beginning March 20, a comprehensive exhibit of railway appliances used in the construction, maintenance and operation of American railways.

This exhibit, which is conducted under the auspices of the Railway Appliances Association, gives a good idea of the remarkable development that has taken place in railway engineering during the last year. The devices which are being shown exemplify many improvements in the design, use and manufacture of signaling materials.

The list of exhibitors includes many representative firms in the electrical industry. Of particular interest to signal engineers are the exhibits of the General Electric Company, the Duplex Metals Company, the Kerite Wire & Cable Company, the Okonite Company and many others. The following is a partial list of those making exhibits and the articles displayed:

The American Railway Signal Company, Cleveland, O.: Electric automatic signals, electric switch locks, electric dwarf signals, tower and switch indicators, relays and electric interlocking apparatus. Represented by G. L. Weiss, H. M. Abernethy, H. D. Abernethy, J. L. Burrows.

American Steel & Wire Company, Chicago: Right-of-way fencing, gates, signal wire, rail bonds, tie marking nails. Represented by J. M. Holloway, L. P. Shanahan, S. F. Deems, H. A. Parks, B. H. Rider H. S. Durant, C. S. Knight.

Banks Electric & Manufacturing Company, 200th Street and Webster Avenue, New York City; Banks' signal batteries, Banks' track batteries. Represented by W. C. Banks, G. W. Davis, John H. Bush.

W. F. Bossert Manufacturing Company, Utica, N. Y.: Triple-lock switch stand, Bossert insulated rail joint, Nickerson safety switch point lock, Bossert improved switch point adjuster, tie plate and guard rail clamp, semaphore blade clasps, Simplex and Duplex track drills. Represented by F. L. Guillaume, W. F. Bossert, H. C. Williams, R. E. King, of Utica, N. Y., and Willis C. Squire, Chicago.

Bryant Zinc Company, 600 Orleans Street, Chicago, and 90 West Street, New York City: Signal supplies, battery supplies, fibre conduit, Gould storage batteries, crossing bells, battery vaults and chutes, electrical instruments, track and linemen's tools. Represented by A. F. Klink, E. M. Deems, R. N. Baker, Stanley Bryant, H. J. Hovey, R. N. Chamberlain, J. W. Cremerius.

Chicago Pneumatic Tool Company, 1010 Fisher Building, Chicago: Section motor cars, pneumatic and electric tools. Represented by C. E. Walker, J. G. Osgood, C. B. Coates.

Joseph Dixon Crucible Company, Jersey City, N. J.: Dixon's Silica-Graphite paint, graphite productions. Represented by H. W. Chase, E. R. Smith.

Duplex Metals Company, Chester, Pa.: Miniature pole line showing results from heavy snow storm; samples of all kinds of copper-clad steel wire and products, such as nails, cotter pins and bolts. Represented by Frank R. Chambers, Jr., W. T. Kyle, G. P. Fondersmith, W. W. Lampkin, E. M. Fondersmith.

Edison Manufacturing Company, Orange, N. J.; Chicago, Ill.: Primary batteries for signal work, automatic block signals, crossing bells, telephone circuits and gas engine ignition. Represented by E. E. Hudson, E. J. Lepreau, E. W. Brown, P. A. Garrity.

Edison Storage Battery Company, Orange, N. J.; Storage batteries of various types, portable and stationary, for railway signal application; car lighting and ignition batteries. Represented by H. G. Thompson.

Electric Storage Battery Company, 1424-28 Marquette Building, Chicago: "Chloride Accumulator" batteries for drawbridge operation, and Chloride, Tudor and Exide types for car lighting, electric interlocking plants and automatic block signal work; couple types for small lighting plants, telephone and telegraph service. Represented by G. H. Atkin, T. Milton, R. E. Baird and T. A. Cressey.

Fairbanks, Morse & Company, 481 Wabash Avenue, Chicago, Ill.: Motor cars for section work and inspection, also for signal and telegraph departments; gasoline pumping engines, steam pumps, railroad pumping windmills, standpipes, gasoline and gas-engine generating sets, motors and dynamos, track and bonding drills, ratchet, ball-bearing and hydraulic jacks; scales. Represented by S. F. Forbes, C. W. Kelly, A. A. Taylor, F. M. Condit, L. H. Matthews, all of Chicago; E. M. Fisher, Detroit; G. J. Akers, Boston; A. F. Young, F. V. Roy, L. Norvell, St. Louis; H. D. Smith, St. Paul; A. C. Dodge, F. H. Douglas, New York; W. H. Stearns, Atlanta; C. T. Fugitt, Norfolk.

General Electric Company, Schenectady, N. Y.: Railway signal and accessory and supply devices, mercury arc rectifier, gasoline-engine generating set and railway signals in operation. Represented by Frank Rhea, H. K. Ferguson, F. B. Corey, L. A. Hawkins, W. W. Brown, A. G. Moore, H. L. Monroe, C. Ives, R. E. Russell, A. W. Jones, A. P. Jenks, L. G. Crawford, J. S. Button.

General Railway Signal Company, Rochester, Chicago, and New York City: Electric interlocking machines, Model 2-A, electric motor signals for automatic block and interlocking systems, relays and other devices. Represented by W. W. Salmon, G. D. Morgan, M. Wuerpel, W. K. Howe, F. L. Dodgson, H. M. Sperry, J. L. Langdon, C. O. Poor, J. B. Evans, M. R. Briney, F. H. Jones, G. H. Macdonnough, W. R. Young.

The Hall Signal Company, New York and Chicago: Automatic signal appliances. Represented by W. J. Gillingham, H. L. Hollister, W. H. Lane.

H. W. Johns-Manville Company, New York and Chicago: Asbestos and magnesia materials, electrical supplies, roofings, smoke jacks. Represented by J. W. Meek, J. C. Younglove, F. M. Gilmore, P. C. Jacobs, G. A. Nichol, C. E. Murphy, H. G. Newman, F. W. Doty, W. J. Hennessy, George Christensen, G. W. Gearhart.

Kellogg Switchboard & Supply Company, Chicago: Railway telephone equipment including train dispatching sets, various types of portable telephones, siding telephones and ordinary telephones for use on both steam and electric roads. Intercommunicating sets, composite telephones, insulated telephones and private branch exchanges. Represented by J. C. Kelsey, G. A. Joy, W. Booth, Archibald Wray.

Kerite Insulated Wire & Cable Company, 30 Church Street, New York City: Kerite insulated wires and cables. Represented by R. D. Brixey, Azel Ames, P. W. Miller, J. A. Renton; Western representative, Watson Insulated Wire Company, Chicago, Ill.; J. V. Watson, B. L. Winchell, Jr., E. B. Price.

Lidgerwood Manufacturing Company, 1917 Fisher Building, Chicago: Hoisting engine. Represented by Frank B. Knight, W. G. Wilmot, E. C. Reeder.

W. N. Matthews & Brother, 219 N. Second Street, St. Louis, Mo.: Matthews' guy anchors, cable clamps, cable splicing joints, lamp guards, guy clamps and other money saving specialties. Represented by Claude L. Matthews, W. N. Matthews, Victor L. Crawford, Walter E. Bischoff, A. P. Eckert.

The Okonite Company, 253 Broadway, New York: Okonite wires; aerial, underground and submarine cables for all kinds and conditions of electrical service; potheads; cable joints; Okonite and Manson tapes; samples of crude rubber, etc., etc. Represented by J. S. Langan and L. G. Martin of New York, and J. M. Lorenz, H. M. Cox and C. E. Kacin of the Central Electric Company, Chicago, Ill., general western agents of the Okonite Company.

The Rail Joint Company, 185 Madison Avenue, New York, N. Y.: Continuous Weber and Wolhaupter types, base supporting rail joints. Represented by V. C. Armstrong, L. F. Braine, W. E. Clark, J. A. Greer, Percy Holbrook, H. C. Holloway, J. G. Miller, F. A. Poor, E. L. Van Dresar, B. Wolhaupter, F. C. Webb.

Standard Underground Cable Company, Chicago Office, The Rookery: Bare and insulated copper wires, bare and insulated copper-clad wires. Represented by H. P. Kimball, R. G. Harris, E. J. Pietzcker, Russell E. Green, B. S. Stewart.

United States Electric Company, New York and Chicago: Manufacturers of the Gill selector, railway signals and electrical devices. Designers of railway telephones. Consulting electrical engineers. Represented by W. L. Cook, E. E. Backus, M. E. Launbranch.

U. S. Wind Engine & Pump Company, Batavia, Ill. Water columns, tanks, tank fixtures, steel substructures (all in model), switch stands. Represented by L. E. Wolcott, A. J. Anderson, C. E. Ward.

Western Electric Company, New York, Chicago: Railway telephones for train dispatching, siding telephones, portable telephones for train crews and all telephone apparatus, fan motors, arc lamps, installation material; Buffalo grips, Mazda lamps, bells and buzzers. Represented by G. H. Porter, D. C. Guest, M. A. Oberlander, G. K. Heyer, W. H. Doherty, H. L. Grant.

Central Electric Railway Association.

The regular bi-monthly meeting of the Central Electric Railway Association was held in the auditorium of the Hartman Hotel, Columbus, O., March 23. "Development of Long Distance Travel Over Interurban Roads," and "Interurban Line Accounting," were the subjects of the principal papers to be presented at the forenoon session. The afternoon session was devoted to reports of committees followed by a discussion of the use of sand on interurban cars and the use of asphaltic oils as economical wood preservatives. A special train was run from Indianapolis.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

Economy of a Producer-Gas Plant.

The economy of a producer gas-engine plant for central-station operation is well illustrated in the case of the Everton Electric Light & Power Company, of Deer River, Minn. This company, in addition to its regular lighting and power load, furnishes all current for street lighting, operating under a twenty-year franchise, which necessitates running the plant eighteen hours per day.

The generating equipment at Deer River comprises an eighty-horsepower Muenzel gas engine of the Minneapolis Steel & Machinery Company's manufacture, direct-connected to a fifty-five kilowatt direct-current generator. An eighty-horsepower anthracite-coal gas-producer supplies the engine. This installation was completed last year at a cost of $6,500.

The Everton Electric Light & Power Company has recently completed a running test extending over a period of ninety days, which resulted in obtaining some noteworthy figures. The test was made on a forty-three-ton car of pea coal as a basis, the cost of coal being $7.40 per ton in the bin at the power house.

The load of the Deer River station varies from fifteen horsepower to eighty-five horsepower per day, making an average horsepower load of fifty for the day's run of eighteen hours. Using 86,000 pounds of coal for the generation of 81,000 horsepower-hours during the test period of ninety days makes the coal consumption for fifty horsepower for eighteen hours 955 pounds or $3.53 for the cost of fuel per eighteen hours. Other costs per day were found to be: engineer's salary $4.30, oil twenty cents, water rent twenty-five cnts, insurance sixty-five cents, and depreciation (at five per cent) $1.93, making a total cost per day of $10.86 for 900 horsepower-hours, or $.0162 per kilowatt-hour. The Company states that the plant has given very satisfactory service and that the repair bill for the year has been less than $100.

EIGHTY-HORSEPOWER GAS-PRODUCER PLANT.

DIRECT-CONNECTED GAS ENGINE AND GENERATOR.

Hydroelectric Plants for Milan, Italy.

The lighting system of Milan, Italy, is being changed from gas to electricity, and the first and most important of the five water-power plants to furnish the necessary power is now in operation. These five plants are all to be in the Valtelline Alps,, in Lombardy, ninety-three miles from Milan, and are a section of a $6,484,000 project by the Commune of Milan, which carries out both construction and operation. It has not been decided when the other four water-power plants will be commenced. There will be a good opportunity for American firms to submit bids for the furnishing of machinery, turbines, dynamos, pumps, etc.

Equipment for Jacksonville Station.

The type of construction and equipment of the new power station of the Jacksonville (Fla.) Electric Company has been decided by the Stone & Webster Engineering Corporation which has charge of the design and construction.

The building will be of steel-frame and brick construction and the stack will be of reinforced concrete. The principal power equipment will be two 1,800-kilowatt maximum-rated General Electric direct-current generators coupled respectively to two 2,400-horsepower cross-compound engines to be built by the Nordberg Manufacturing Company. There will be three 600-horsepower boilers from the Edge Moor Iron Works. The condensers will be of the barometric-column type and will be supplied by the Mesta Machine Company. The principal coal-handling apparatus will be a seventeen-ton Industrial Iron Works locomotive crane.

EUROPEAN SWITCHBOARDS OF STEEL, IRON AND CONCRETE.

BY STEPHEN Q. HAYES.

To an American engineer the term switchboard usually suggests a collection of marble or slate panels containing the various instruments, switches, rheostats, etc., needed for the control of the generators and feeders in a power house. Such panel boards of slate or marble while occasionally found in Europe, are not so nearly universal as with us, as in European plants of moderate or large capacity for alternating-current service it is customary to use cabinets, desks, pedestals, posts or similar devices, or if a panel board is used to make it of steel plate with a structural-iron frame placed on wheels forming the so-called "Wagon-Panel System" found in many of the German power plants.

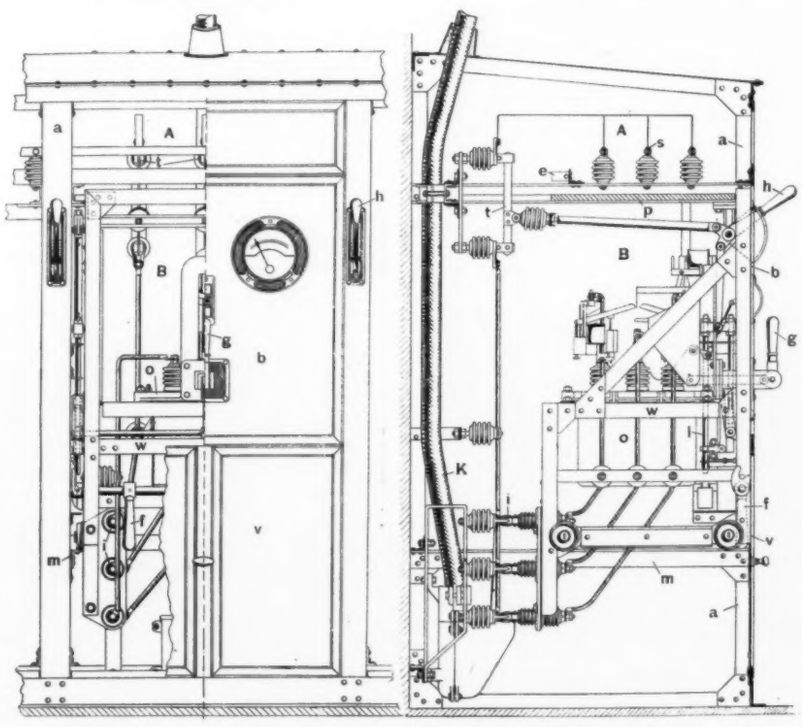


FIG. 1.—ELEVATION AND SECTION OF LAHMEYER WAGON-PANEL.

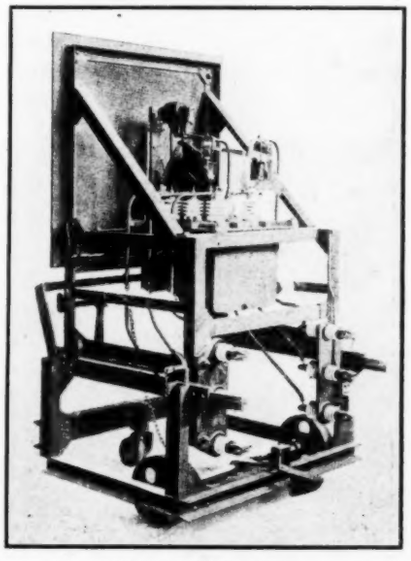


FIG. 2.—REAR VIEW.

Fig. 1 shows a front and side view of a small wagon panel supplied by the Felten & Guilleaume Lahmeyer-Werke Aktien Gesellschaft of Frankfort and this illustrates in detail some of the principal features of this system which is so popular with German manufacturers. Its popularity is due to the fact that all of the busbars, oil circuit-breakers, instrument transformers and similar devices are completely closed in and practically inaccessible to the stray visitor or station attendant under ordinary conditions. After the proper precautions are taken, however, the whole panel with its oil breaker and other appliances can be inspected in absolute safety.

A suitable structural-iron framework is furnished with this system and usually located against one wall of the station so that there is no "back" to the switchboard. This framework supports the busbars, the incoming leads, the stationary jaws of the disconnecting switches and acts as a support for the movable carriage.

This movable carriage is made of steel plate and structural iron and contains the oil circuit-breaker, relays, meters, etc., and is provided with all of the interlocks needed to make its operation practically foolproof.

As may be noted, a three-conductor feeder cable *K* is brought in through the top of the compartment to a cable bell, whence single-conductor leads are carried to knife contacts mounted on insulators *i* attached to the stationary framework, and these knife contacts engage with corresponding jaw contacts mounted on insulators attached to iron framework *W* of the rolling carriage that supports the oil circuit-breaker with its mechanism. The leads after passing through the oil circuit-breaker go to corresponding jaw contacts on the other side of the breaker, which jaw contacts engage with stationary contacts that in turn are connected to the busbars *s* through the manually operated three-pole disconnecting switch *t*. When this switch is opened its three blades rest against an angle-iron cross brace that is provided with a ground connection *e*, this completely earthing all of the apparatus. The handle *h* for this disconnecting switch *t* mechanically interlocks with the handle *g* of the breaker so that the disconnecting switch cannot be pulled until the breaker is opened, nor can the wagon panel be slid out on its wheels until the disconnecting switches are opened. As may be noted, the busbars *s* are in a compartment *A* separated by an insulating shelf *p* from the room *B* containing the rest of the apparatus. A suitable carriage as shown in Fig. 2 is provided so that the oil circuit-breaker and its devices may be rolled out into the passage way and placed on this carriage for removal, inspection and all repairs. As a rule in installations of this kind the indicating meters are mounted in the steel front of the wagon panels.

The oil circuit-breakers used with these wagon panels can, of course, be made electrically operated or hand-operated as desired. In this arrangement of wagon panels there is no back, properly so-called, to the switchboard,

but the assembled panels are placed directly against the station wall occupying a comparatively small amount of space. Occasionally, however, sufficient space is provided back of the wagon-panel switchboard so that any individual wagon panel can be removed either to the rear or the front.

Fig. 3 shows the rear view of a wagon-panel switchboard supplied by the Siemens-Schuckert Werke of Berlin to the Hamborn Station of the Deutscher Kaiser Colliery, where it is located along one wall of the power house with ample space so that the panel may be withdrawn to the rear or to the front. This switchboard is arranged for the control of 1,900-kilovolt-ampere, 5,500-volt, fifty-cycle, three-phase generators and a large number of three-phase feeder circuits.

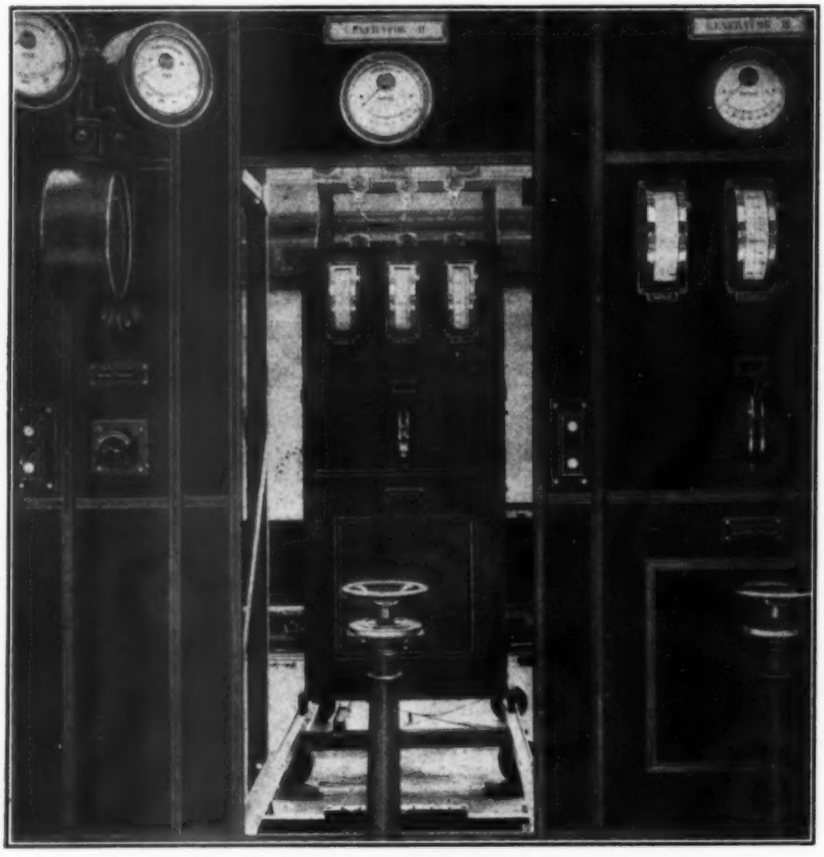


FIG. 3.—SIEMENS-SCHUCKERT WAGON-PANEL SWITCHBOARD.

This view shows one of the cell carriages for a generator equipment withdrawn to the back of the board. Each of the generator wagon panels is provided with an oil-switch hand lever, ammeter, voltmeter and wattmeter, these instruments being the vertical edgewise type and set in the steel front of the wagon panel. A round-pattern field ammeter is placed on the portion of the framework that is not attached to the moving frame.

The wagon panels supplied by the Maschinenfabrik Alioth of Munchenstein-Basle to the Montbovon Station of the Montreux-Bernese Oberland Railroad in Switzerland, for the control of three-phase 8,600-volt feeder circuits, are placed far enough out from the station wall to allow ample room for the leads to the bus and the feeder. The oil switch is mounted on a movable framework and is provided with a three-phase oil-immersed series transformer supplying current to the three-pole time-limit relay mounted on a base. The movable and stationary contacts form the equivalent of a six-pole disconnecting switch with barriers between the various poles. Porcelain pillar-type insulators are used for all of the high-tension wiring. A set of auxiliary contacts is used for the leads to the instruments located in another room.

Fig. 4 shows a portion of the wagon-panel switchboard supplied by the Allgemeine Elektricitäts Gesellschaft of Berlin for the International Electric Company of Vienna. The front of this board is made of steel plates with the round-pattern and vertical edgewise instruments set flush in the face of the panels. The illuminating lamps project out on brackets in front of the board and are provided with reflectors to concentrate the light on the instruments. The voltmeters and similar instruments required for parallelling are on brackets projecting out from the front of the board.

A typical arrangement of wagon panels, circuit-breakers and busbars for this system as installed by the Allgemeine Elektricitäts Gesellschaft is shown in Fig. 5, and is intended for the control of five three-phase generators and a large number of three-phase feeders, the switching equipment being placed at the end of the building and the switchboard, properly so-called, being placed on a platform and forming part of the wall of the generator room.

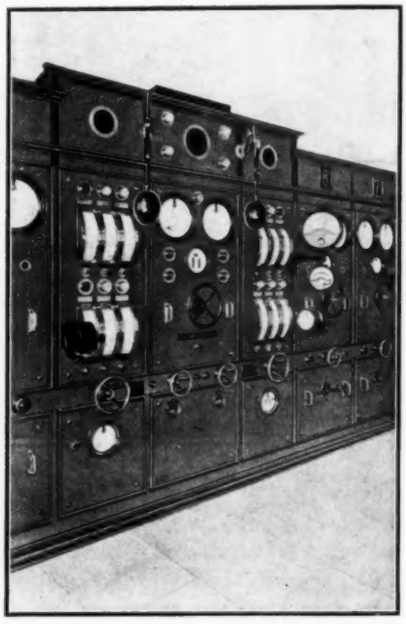


FIG. 4.—ALLGEMEINE WAGON-PANEL SWITCHBOARD, VIENNA.

The electrically operated oil circuit-breakers with their disconnecting switches, busbars, instrument transformers, etc. for the generator circuits and for the feeder circuits are located on three galleries back of the switchboard panels.

The oil circuit-breakers are mounted on wagon panels, that is, the breaker is mounted on a framework provided with wheels, arranged so that it can be

rolled out into the passage way for the purpose of inspection and repairs. Jaw contacts are provided which automatically connect the switchgear into circuit when the wagon panel is pushed back, and which, of course, entirely disconnect the wagon panel when it is pulled out. Interlocking devices are provided so that it is impossible to pull out the wagon panel unless the breaker is in the open position.

on panel and the selector disconnecting switches to the two sets of busbars and back again in a similar manner to the feeder cables.

Other European manufacturers employ a modification of the wagon-panel system, where each circuit is provided with a cabinet of steel or cast iron containing the switches and instruments, and these are assembled in groups and provided with busbars. Elaborate interlocks are furnished, which make it practically impossible to gain access to the high-tension circuits while they are alive.

with the necessary instruments, with the handwheels and handles to control the oil switch in the armature circuit of the generator, the switch and rheostat in the generator field and the necessary appliances for synchronizing. The cabinet proper is made of concrete and steel and contains all of the high-tension apparatus for the generator circuits. The back of the cabinet is closed by a rolling steel door which cannot be opened until the disconnecting switches have been pulled to isolate the cabinet from the busbars.

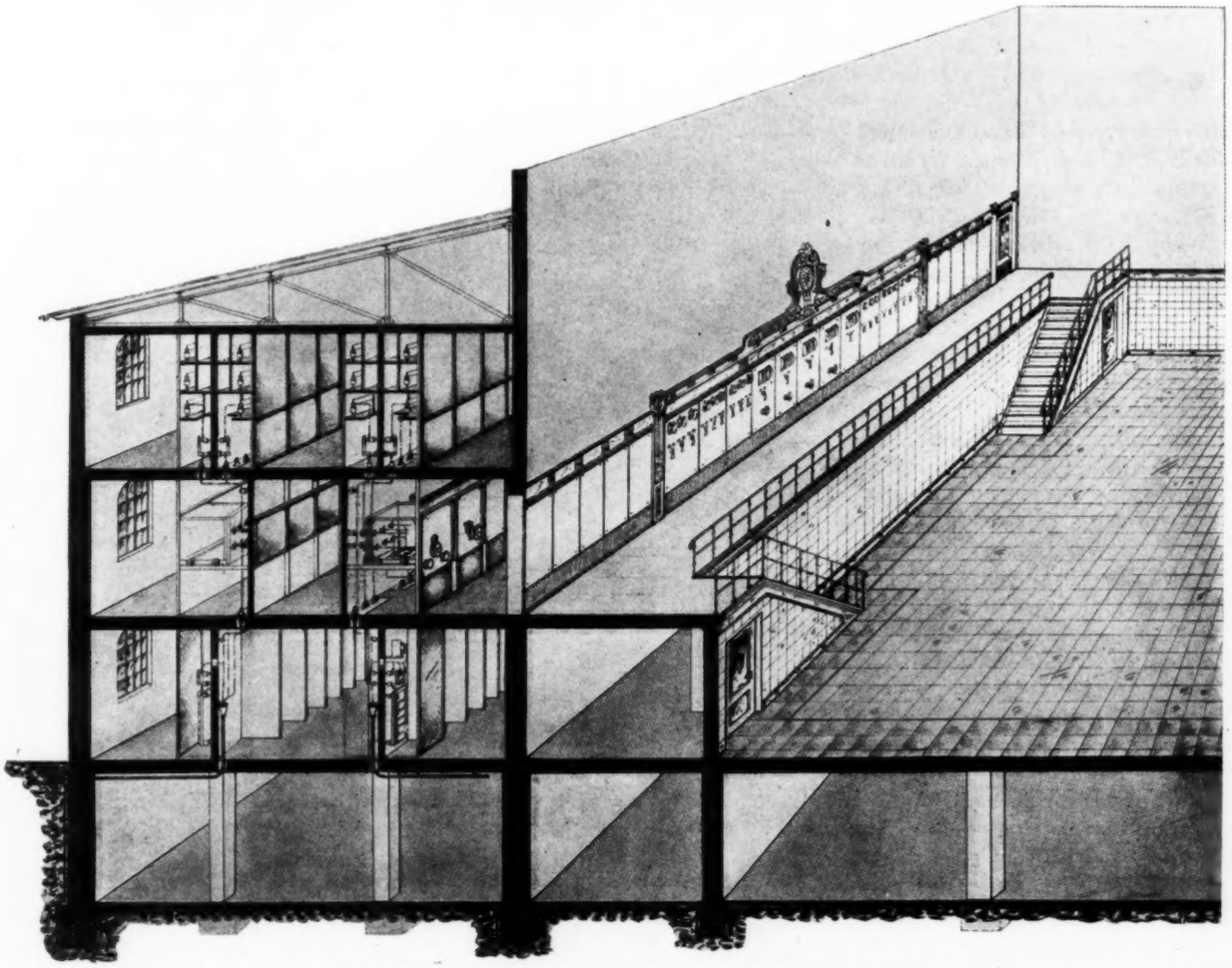


FIG. 5.—ALLGEMEINE WAGON-PANEL SWITCHBOARD.

As may be noted, the arrangement of the busbars and supports with their disconnecting switches does not differ very materially from standard American practice, the busbars of bare copper strap being supported on pin-type insulators, and concrete shelves being provided between the busses. Removable doors are furnished in front of the busses to facilitate inspection.

The path of the circuits can easily be followed from the three-conductor generator cable through the disconnecting switches, the breaker with its wag-

Still another modification of this system is the cabinet scheme adopted by the Maschienfabrik Alioth at the Hauterive Generating Station. In this station, as shown in Fig. 6, each generator is provided with a cabinet whose front is in the generator room and which projects through the wall so the rear is in the adjoining busbar room. The front of the cabinet is provided

In other plants the oil breakers and high-tension apparatus are all placed in concrete compartments or screened mechanically from the operating platform where the switchboard, desk, pedestal or similar control device is located.

Fig. 7 shows a combined control desk and switchboard supplied by the Allgemeine Elektricitäts Gesellschaft for the Jacobstrasse Substation of the

Berlin Electricity Works for the control of motor-generator sets, transforming from alternating to direct current. Illuminated-dial voltmeters are mounted on swinging brackets at the end of the board, and each section is provided with ammeter voltmeter, power-feeder meter and field ammeter for the synchronous motor, with ammeter and voltmeter for the direct-current generator. Controllers with red and green bulls-eye signal lamps are provided for the various circuit-breakers with all the necessary synchronizing and voltmeter receptacles and plugs. As may be noted, the profile edgewise instruments may be mounted vertically or at a slight slant from the horizontal.

Fig 8 shows a typical control desk supplied by the Brown Boveri Company for the Piedimulera generating station of the Dell-Anza system in Italy for the control of two 150-kilowatt exciters and four 2,450-kilovolt-ampere, 8,000-volt three-phase generators each with its own three-phase transformer stepping up to 45,000 volts. With this type of desk the operator faces the station and can readily observe the machines he is controlling. The connections are so made in this plant that normally each generator is tied in solidly to the low-tension side of its own step-up transformer, but a sufficient number of disconnecting switches is provided to allow any generator or transformer to work together on a relay bus.

This control desk is built with sheet-steel plates forming the front ends and back, and cast-iron top. The section at the extreme right controls the two exciters and is provided with two handwheels for the exciter switches, two handwheels for the exciter rheostats and a radial voltmeter switch, while the post contains an ammeter for each exciter and a voltmeter. The second and third sections from the right-hand end each control a generator with its step-up transformer and each is provided with a two-pole overload time-limit relay, a field-rheostat handwheel, a field ammeter, set flush in the desk, two instrument switches, a control switch with red and green signal lamps for the high-tension oil breaker and synchronizing lamps, while the pillar contains the generator ammeter, voltmeter and synchronizing voltmeter.

The fourth section is intended for a future line and is at present provided with a master handwheel to operate simultaneously the rheostats of the generators feeding that particular line. The fifth section is blank and is used as a writing table for keeping the station records. The sixth section controlling the outgoing line is provided with a master handwheel for the simultaneous operation of the generator rheostats and it should be noted that either of the master handwheels and any of the generator-rheostat wheels can be connected to either of two driving shafts so that either master handwheel can drive any of the generator rheostats while the other master handwheel drives the rest. This section also contains three profile ammeters, one in each phase of the line, a three-pole time-limit overload relay, parallelling equipment control switch and signal lamps for the line breaker, while the post contains the line voltmeter for synchronizing.

The seventh and eighth sections are for generator control and are duplicates of the second and third sections, while the ninth is a blank section for a future generator. The large voltmeter on the wall is a line voltmeter.

Fig. 9 shows a control desk of very similar design built by the Siemens-Schuckert Company with round-pattern and profile-type instruments set

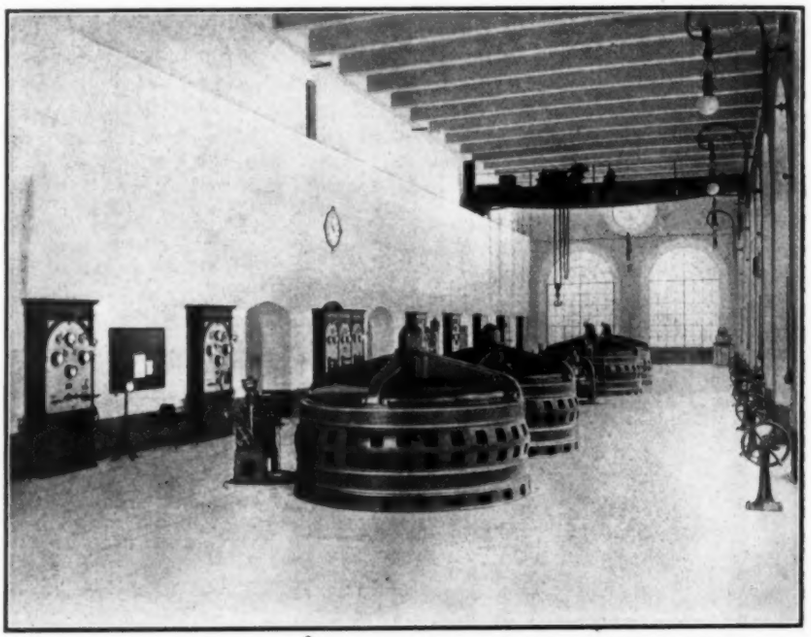


FIG. 6.—ALIOTH CABINETS, HAUTERIVE GENERATING STATION.

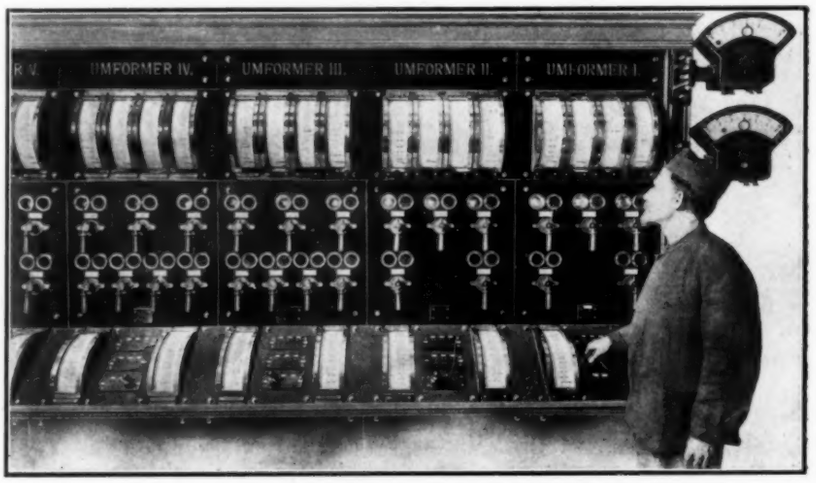


FIG. 7.—ALLGEMEINE CONTROL DESK, BERLIN.

in the cast-iron top or apron of the desk in such a manner that they can be tilted at any angle desired by the operator to secure the best readings. The front of the desk is made of embossed sheet iron, as are the ends and the back. The overload time-limit relays are provided with glass covers

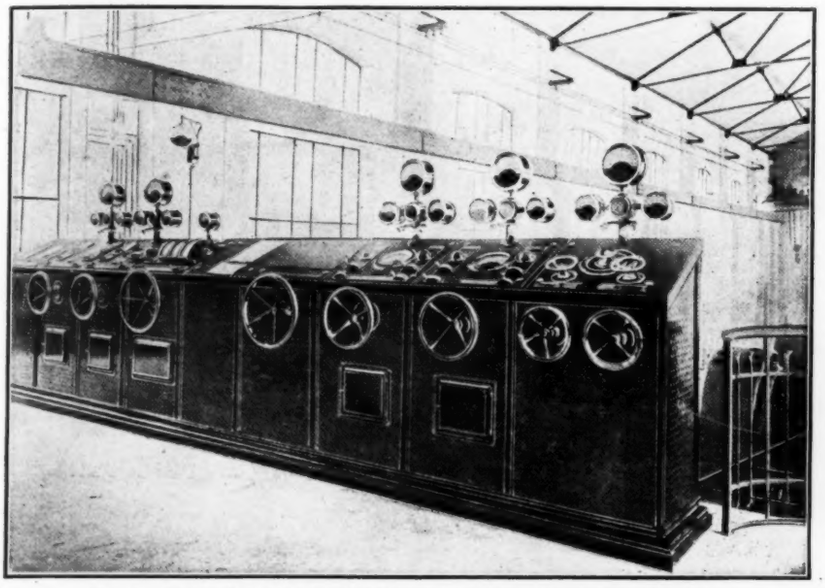


FIG. 8.—BROWN-BOVERI CONTROL DESK, PIEDIMULERA STATION.

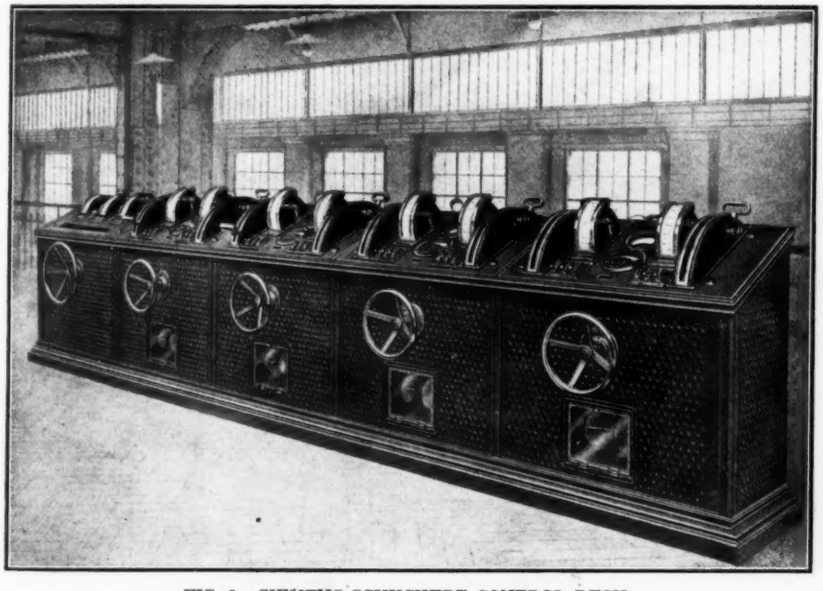


FIG. 9.—SIEMENS-SCHUCKERT CONTROL DESK.

and set in the front of the desk below the handwheel which controls the oil circuit-breakers. The generator and exciter field rheostats are controlled by the large segmental devices on the apron of the desk, while the smaller ones are signal switches.

Instead of a control cabinet or desk, pedestals are frequently used by European manufacturers of switchboards.

Fig. 10 shows the equipment furnished by the Siemens-Schuckert Company for the Altona plant for the control of a large number of turbo-generators. Each pedestal is equipped with a main ammeter, voltmeter and wattmeter with the necessay control switches, exciter and generator rheostat handwheels, signal devices, receptacles, push-button switches, etc. The pivoted brackets attached to the columns of the gallery contain the bus instruments while graphic recording meters are attached to the same columns. Push-button control with signal lamps is used for the electrically operated oil circuit-breakers in the generator circuits.

The standard practice of the Maschinen Fabrik Oerlikon, of Oerlikon near Zürich, favors the use of pedestals for generator control with panels for the feeder circuits.

Fig. 11 shows the operating gallery of the Castelnuovo power plant installed in the north of Italy near the mouth of a coal mine, to utilize a very poor grade of lignite coal. The station contains three 1,800-kilovolt-ampere 6,000-volt, three-phase, fifty-cycle generators built by the British Westinghouse Company and supplying power through three banks of step-up transformers to the 33,0000-volt outgoing feeders.

The two pedestals in the background are used for the control of the steam-driven and motor-driven exciters, the three pedestals in the foreground are used for the generators, and the panel switchboard is used for the control of the step-up transformers and the feeder circuits. The gallery is so arranged that the attendant faces the generator room when standing at the control pedestals.

Each exciter control pedestal carries an ammeter, voltmeter, handle for two-pole automatic circuit-breaker, and field-rheostat handwheel. Lamp signals are furnished to show the position of the exciter breaker. One of the exciter columns also contains the apparatus for the exciter motor.

The generator columns are each provided with one main ammeter, one field ammeter, a double-scale voltmeter for synchronizing, a polyphase wattmeter and the signal lamps for the automatic breaker. The three levers to the right of the column are used for the three oil breakers in the generator and transformer circuits suitably interlocked.

A two-pole carbon-break field switch and the generator field rheostat are controlled by handwheels.

On the panel switchboard the blank panels at the extreme left-hand end are for future transformer banks. The next three are each used for the high-tension side of a bank of transformers and each contains three ammeters, two signal lamps, the operating handle for the high-tension transformer switch and an overload time-limit relay. The next panel controls the local-service

circuits while the next two are load panels with ammeters and polyphase graphic recording wattmeters. The panels at the right-hand end control the five line circuits and each contains three ammeters, two sets of signal lamps and one control switch for the automatic line breaker, one overload inverse time-limit relay for same, one control switch for a non-automatic switch connecting the feeder to a testing bus provided with ohmmeters.

The practice of the European branches of the Westinghouse Company and the General Electric Company follows closely that of their parent American companies, so the preceding cuts and descriptions may be considered as fairly representative of strictly European alternating-current switchboard design and show the prevalence of iron and steel in place of marble or slate for what may be considered as comprising the "switchboard" in the narrow meaning of that term as a place for mounting the instruments and control devices.

Practically the entire development of this iron or steel switchboard hinges on the use of oil switches or circuit-breakers for the main alternating-current circuits and a few examples of European design of such devices with the structure of concrete or iron gratings for inclosing the devices may be of interest.

As the essential feature of the oil breaker is the opening of the circuit under oil and the smothering of the arc in a rather restricted space, it was found that the explosions that occasionally occur when circuits of large power are opened under oil would sometimes rupture the oil tanks or even destroy the breaker. The amount of power that could safely be handled by an oil circuit-breaker depended on the strength of tanks, amount of oil and similar features of design and in general it was not safe to use a small breaker on a system of large capacity if, under certain easily possible conditions, the breakers might be called on to open a short-circuit with the entire power of the station concetrated on it. As the result of long tests and experience it has become customary in America, to assign an ultimate breaking capacity to various types of breakers. This is usually given as the maximum kilovolt-ampere capacity, in normal rating of generators connected to the bus, on which it is safe to use a certain breaker. As an actual fact, the maximum current seems to have more to do with breaking capacity than the kilovolt-amperes and it is usually a simpler problem to control a 10,000-kilovolt-ampere current at 66,000 volts than at 6,600 or 600 volts.

While the ultimate breaking capacity of oil breakers has not been usually stated by European makers, owing to the comparatively small number of European plants with generator capacity in excess of what could readily be handled by a moderate-size breaker, the fact that explosions do occur occasionally that blow oil out of the switches and sometimes wreck the tanks has not been lost sight of, and the switches are usually so located that their failure will cause little or no damage to other apparatus.

The design of the European circuit-breakers is, of course, based on securing a device that will satisfactorily open the circuit of the particular machines, transformers and feeders in which it is used, and the different manufacturers have developed their switchgear to suit their conditions and practice. The different makers have developed fairly complete lines of oil breakers for all voltages, but due to the natural limitations of a short paper only typical designs of a few

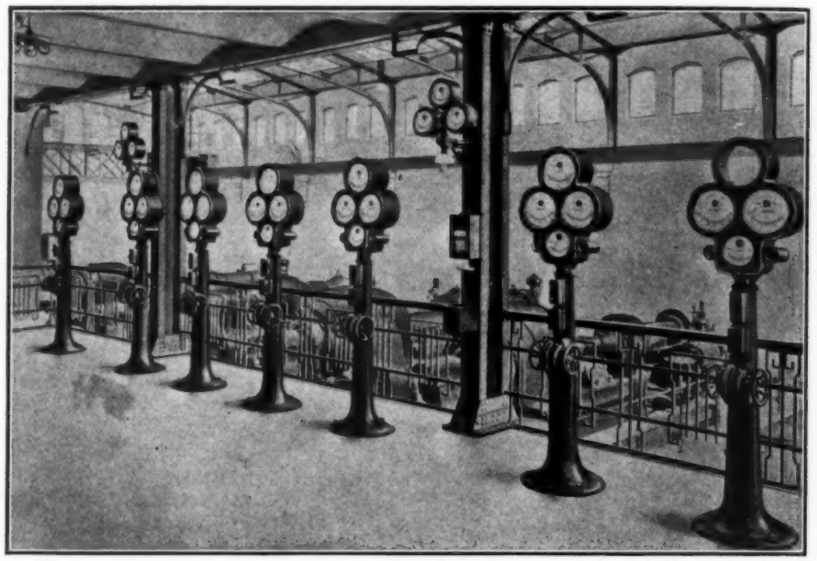


FIG. 10.—SIEMENS-SCHUCKERT CONTROL PEDESTALS, ALTONA STATION.

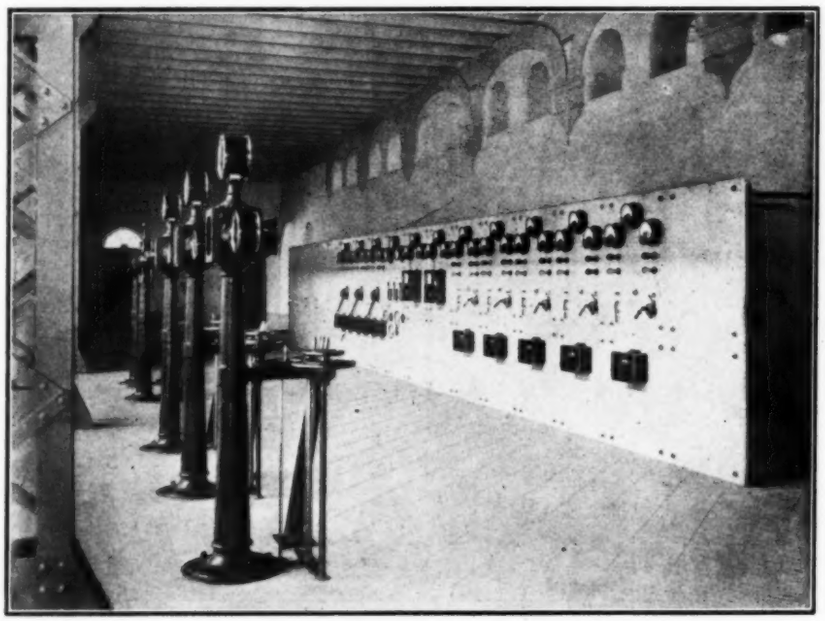


FIG. 11.—OERLIKON CONTROL PEDESTALS, CASTELNUOVO PLANT.

makers have been selected as illustrating European practice, and a few installations have been shown to indicate the methods of arranging the breakers with concrete compartments or their iron-grating inclosures. A fairly complete set of oil breakers made by the Maschinenfabrik Oerlikon have been selected as showing the general trend of European design and the illustrations of breaker installations have been selected from plants put in by other companies.

Fig. 12 shows a 150-ampere, 10,000-volt, three-pole hand-operated oil circuit-breaker for direct control with overload time-limit relay and signal switch. The oil tank, which has been removed in this picture, is provided

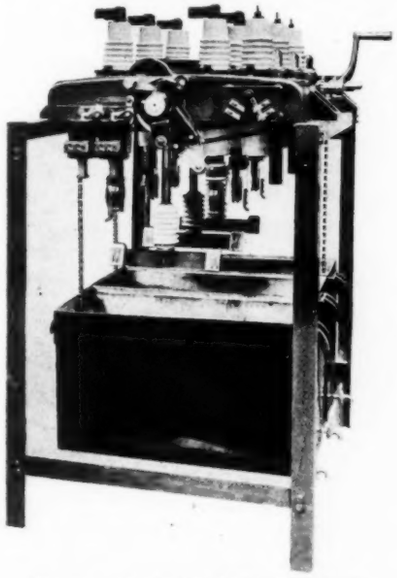


FIG. 13.—HAND-OPERATED CIRCUIT-BREAKER.

with lifting handles and oil cock and is of such a design that the relay device and operating mechanism are outside the tank. For distant control the handle shown is replaced by a wheel or crank arm attached to the extended shaft in such a manner as to facilitate its operation by rope or rod drive and the two-pole double-throw small-jaw switch on the top casting of the oil switch is used to light up the signal lamps on the control platform. The stationary contacts are attached to insulators set in the cast-iron top, the main contacts being of laminated brush construction, while the auxiliary contacts are of stiff spring metal bearing on the wedge-shaped movable contacts.

Fig. 13 shows a three-pole oil circuit-breaker, 300 amperes, 20,000 volts, overload automatic, with intermediate contacts for connecting resistances in the three-phases. It may be noted that the main stationary contacts are of wedge shape and that in addition there is a secondary finger contact bearing

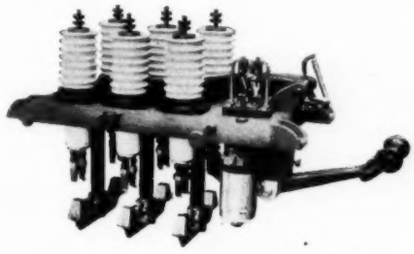


FIG. 12.—OERLIKON CIRCUIT-BREAKER.

on the end of the movable contact and mounted on a porcelain collar so as to be insulated from the main contact. These auxiliary contacts have their connections brought out through independent porcelain tubes and the resistance is connected outside the breaker. As a matter of interest the Oerlikon Company states the resistance has been found to materially increase the breaking capacity of this breaker, but they have no exact data as to the amount of this increase. The tank-lowering device, the signal switches and the other mechanical parts of the circuit-breaker are clearly shown, and the use of metal operating rods with porcelain insulators for carrying the movable contacts is quite a departure from American

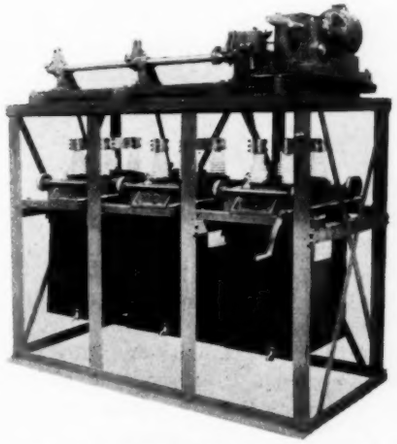


FIG. 14.—MOTOR-OPERATED CIRCUIT-BREAKER.

practice, but illustrates the dependence placed on these porcelain insulators.

Fig. 14 shows a 1,600-ampere 20,000-volt, three-pole motor-operated oil breaker with four breaks in series per pole. This breaker is provided with contact tank-lowering mechanism and other devices similar to Fig. 13. The scheme of using several breaks in series for high-voltage breakers is the usual practice in Europe and barriers are provided in the tanks so that each break occurs in what is practically a separate compartment.

Fig. 15 shows the type of 100-ampere, 30,000-volt solenoid-operated three-pole oil breaker supplied by the Oerlikon Company for the 27,000-volt circuits of the Engelberg Lucerne plant. Some of the breakers used in this installation were operated by a

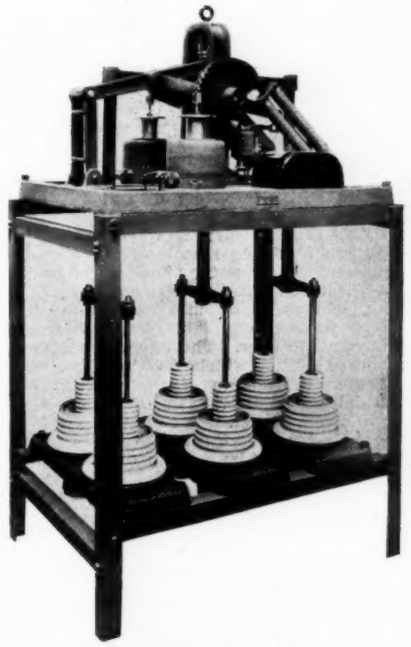


FIG. 15.—SOLENOID-OPERATED CIRCUIT-BREAKER.

rope transmission while the others had solenoids located on the top frame to operate the mechanism. This breaker has two breaks per pole, each occuring in a separate porcelain pot. The connections of the incoming and outging leads are made at the bottom of the pots while the plunger rods enter the top and are attached to cross arms operated from the mechanism on the upper framework. This breaker, like all bottom-connected ones, with vertical break, has the disadvantages that gravity tends to open it rather than close it and sediment is apt to settle on the contacts at the bottom of the oil pots. These breakers are almost invariably installed in concrete structures with barrier-walls between the poles of the breaker.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

Chicago Section, Illuminating Engineering Society.

The March meeting of the Chicago Section of the Illuminating Engineering Society was held in the Great Northern Hotel, Chicago, directly after the noonday luncheon on March 16. James R. Cravath, illuminating engineer, Chicago, presented a paper entitled "Tests on the Lighting of a Small Room," a brief abstract of which follows.

Mr. Cravath's paper gives the results of a series of tests on the lighting of a living room 12 feet by 16 feet 6 inches with a height of 8 feet 6 inches. The ceiling was of a light cream color; the walls had a light green rough paper. Illumination tests were all made in one quarter of the room, which was divided into eight equal sections at the center of each of which a test station was located with a test plate three and a half feet from the floor. The lighting was from a central outlet, which was provided with the same 100-watt tungsten lamp equipped with different glassware in the various tests as follows: A—clear prismatic extensive-type reflector over the lamp at the ceiling, B—bare unshaded lamp, C—opal bowl-shaped reflector, D—indirect lighting using an opaque corrugated mirrored reflector, E—the reflector used in C inverted so as to produce semi-indirect lighting, F—a roughed stalactite globe inclosing the lamp, G—an opal ball inclosing the lamp. With each of these equipments the average foot-candles were determined as follows: A—2.03, B—1.597, C—2.07, D—1.151, E—1.47, F—1.39, G—1.31. The efficiency defined as lumens effective per lumens generated was highest in C and A, 53 and 52 per cent respectively, and lowest in D, 29.5 per cent. The greatest uniformity was obtained with F, with which the ratio of maximum to minimum illumination at the test stations was 3.9; the other extreme was with C, with which this ratio was equal to 11. In tests C, D and E the effect of shading the test plate with an eight-inch disk fifteen inches from the plate was also determined. The percentage reduction by shading was as follows: C—86, D—50, E—61. Among Mr. Cravath's comments on the results was an explanation of why the shading was densest with the direct or semi-indirect systems. The indirect system was found to be the most comfortable when facing the source, the semi-indirect and opal ball following in this respect. The semi-indirect is preferable to the opal ball in the author's opinion because easier on the eyes and more efficient. The ratio of the measured efficiency between a direct system using translucent reflectors and an indirect system in such a room is about three to five. Respecting the shadow effects, the indirect system has the least dense shadows, but is by no means shadowless.

In opening the discussion, G. H. Stickney, of Schenectady, N. Y., spoke of the value of such investigations in which the conditions were definitely known. In interpreting the results the question arises, What use is to be made of the light? If a room of this size is used as an office it has vastly different requirements from a living room. For the latter conditions, to judge from the curves, the semi-indirect system seemed to be the most suitable. There has been too much emphasis on efficiency which in residence lighting is a secondary consideration, he thought. In deciding on the value of a lighting scheme in residences the opinions of the ladies of the household must be considered. That lighting which is the most pleasing is to be chosen for the living rooms. There is great opportunity for adapting electric lights to the artistic requirements, particularly in producing colored lighting effects.

T. H. Aldrich referred to some extensive experiments he is conducting in office lighting by various systems, the results of which are not yet determined. In residence lighting he had found very satisfactory results from indirect lighting. For desk and reading lamps he thought the tantalum lamp the most suitable, as the tungsten was too white, especially if much reading is to be done from glazed pages.

A. Scheible showed by means of a sketch how the relative uniformity of the various systems tested could be more strikingly shown.

A. J. Sweet, of Newark, Ohio, stated that most rooms of this size are a little higher than the one used in the tests. Both the prismatic and opal direct reflectors would have shown up better than they did had they been mounted a little higher. For residence lighting, he thought, there is not so much need for uniformity as in office lighting. A certain controlled non-uniformity is desired. The most important objects in the room should be made conspicuous by a more concentrated lighting of them.

M. G. Lloyd called attention to the relatively small difference in the minimum illumination by the different systems, and suggested that as the wattage to be used in a room should be determined by the minimum illumination desired, the differences in efficiency shown were of little moment.

G. C. Keech illustrated the shortcomings of a single ceiling outlet by a sketch of a room containing a reclining couch, a ladies' writing desk, a piano and several minor pieces of furniture; at each of the more important centers of the room the central lighting scheme produced an entirely inadequate result, a person being compelled to read or write in his own shadow. Therefore auxiliary localized lighting is evidently needed except where a central table only is to be lighted.

Mr. Cravath replied to one of the questions propounded to him by stating that the ladies had been most pleased with a combination of direct and indirect lighting which he had tried out for a short time. In his own opinion the indirect system affords the most comfortable lighting. On account of such long experience with direct lighting, people have not yet become used to having the light source entirely hidden.

Meeting of New England Section, National Electric Light Association.

The annual meeting of the New England Section, National Electric Light Association, was held in the Edison Building, Boston, Mass., on March 17. As the National Association convention is to be held in New York City, May 29-June 3, it was previously voted by the membership of the New England Section to dispense with the program features of the March meeting. Therefore, a business meeting with election of officers and the presentation of different reports was held. The new officers elected are as follows: President, Howard T. Sands, Malden Elec-

tric Company, Malden, Mass.; vice-president, Arthur B. Lisle, Narragansett Electric Lighting Company, Providence, R. I.; treasurer, Welles E. Holmes, Cambridge Electric Lighting Company, Cambridge, Mass.; secretary, Miss O. A. Bursiel, 39 Boylston Street, Boston, Mass. Executive committee, J. A. Fleet, J. S. Whitaker, A. F. Townsend, R. W. Rollins, Geo. S. Haley, L. D. Gibbs, Alex. J. Campbell.

Improvements in Washington Street Lighting.

The District Commissioners of Washington, D. C., are planning to put into effect in the near future a series of further improvements in the street lighting of the nation's capital which will aim to make it the most beautifully lighted city in this county.

The streets which will have their lighting facilities improved immediately are:

Massachusetts Avenue, from Dupont Circle to the Union Station.

Connecticut Avenue, from H Street to Kalorama Road.

Vermont Avenue, from H Street to Thomas Circle.

Seventeenth Street, from K to B Streets.

Pennsylvania avenue, from Fifteenth street to Seventeenth street.

H Street, from Fourteenth Street to Seventeenth Street.

Fifteenth Street, from E Street to K Street.

B Street, from Fifteenth Street to Seventeenth Street.

Madison Place and Jefferson Place.

The streets on the south and west sides of the Treasury Department.

In these improvements the general design used so successfully in Sixteenth Street will be followed both as to the ornamental character of the posts and their spacing. Instead of using eighty candlepower tungsten lamps, 100 candlepower lamps will be employed.

The District will put up its own posts and use its own equipment, as it is believed this will materially reduce the cost of maintaining the lights. It also is the intention of the Comissioners to extend the lighting system to all the business and principal residential streets as soon as possible.

A new reduced schedule of rates has been agreed on between the Commissioners and the local lighting company and this has been approved by Congress. The new rates will permit the Commissioners to begin the extension of the lighting system immediately. They estimate it will take a few years before the system is entirely installed.

The different classes of lamps and the old and new rates are as follows:

Mantle gas lamps of sixty candlepower; old rate, $20.28; new rate, $18.40. The new rate does not go into effect until the expiration of the present contract, July 1, 1912.

Street designation gas lamps or eight candlepower incandescent lamps; old rate, $12.50; new rate, $10.

Forty candlepower, fifty watt, tungsten incandescent lamps on overhead wires; old rate, $20; new rate, $15.

Forty candlepower, fifty watt, tungsten incandescent lamps on underground wires; old rate, $20; new rate, $19.50.

Eighty candlepower, 100 watt, tungsten lamps on underground wires; old rate, $30; new rate, $26. (These are the lamps in use in Sixteenth street.)

100 candlepower, 120 watt tungsten lamps on underground wires; old rate, $35; new rate, $27.50.

200 candlepower, 250 watt, tungsten lamps on underground wires; old rate, $60; new rate, $46.50.

Four-glower Nernst lamps on underground wires; old rate, $65; new rate, $52.50. (These are the lamps in use on the Connecticut Avenue bridge.)

6.6 ampere, 520 watt, direct current, multiple inclosed arc lamps; old rate, $85; new rate, $80.

Five ampere, 550 watt, direct current, multiple inclosed arc lamps; old rate, $85; new rate, $80.

Four ampere, 320 watt, magnetite arc lamps on overhead wires; old rate, $85; new rate, $59.

Four ampere, 320-watt magnetite arc lamps on underground wires; old rate, $85; new rate, $72.50. (This is the lamp which the company is required to install in place of the 700-candlepower lamps.)

Boiler Inspection in New York.

The effectiveness of the work of the Public Service Commission of New York with respect to locomotive boiler inspection is shown by the fact that although there were 307 people injured and nine killed during the past three months in other states, the state of New York reports no deaths and but two injuries.

Sanitary District Current to be Supplied to the South Parks, Chicago.

The South Park Commissioners, having jurisdiction over the extensive park and boulevard system on the South Side of the city of Chicago, have practically concluded a contract with the Sanitary District of Chicago for the supply of electric current to the South Park system. The contract is for five years and is renewable for twenty years or less. Within about a dozen years the peak load for this park system is estimated to be 3,500 kilowatts.

This contract is of particular significance because the Commissioners only a little over three years ago erected a modern steam-turbine-driven generating plant in Washington Park to supply the lighting and power needs of the South Park system. Now it has been found that the Sanitary District's hydroelectric power can be purchased more cheaply than the steam-electric power generated at the new power house. The current will be supplied from step-down transformers as three-phase sixty-cycle current similar to that generated in the steam plant. The latter will be held merely as a reserve for emergency use and may ultimately be dismantled or sold to the Sanitary District as a steam auxiliary.

The contract price is said to be a straight rate of three-quarters of a cent per kilowatt-hour, or a flat rate of $15 per horsepower per year for current used on an average twelve hours per day, plus a charge of twelve per cent to cover interest, depreciation and line losses on the transmission line from the terminal station (Thirty-first Street and Western Avenue) to the point of delivery. The 12,000-volt transmission lines to the Washington Park station and to other substations in this park system are to be run underground.

Through the closing of this contract the Sanitary District of Chicago supplies electric power for practically all the public lighting and power needs (except the waterworks system) of the various municipal bodies in Chicago and Cook County. As these public power demands increase and begin to tax the capacity of the District's Lockport plant, it is expected that the commercial load will be diminished to merely enough to give a good load-factor on the system. Unless the pumping load increases greatly, most of the supply will remain for street lighting.

TELEPHONY—TELEGRAPHY, and WIRELESS.

ANNUAL REPORT OF THE AMERICAN TELEPHONE & TELEGRAPH COMPANY.

GAIN IN SUBSCRIBERS DURING 1910 EXCEEDED 740,000, AND OVER A MILLION MILES OF WIRE ADDED—GROSS REVENUE OF THE BELL SYSTEM $165,000,000, AN INCREASE OF $16,000,000 OVER PREVIOUS YEAR.

President Theodore N. Vail of the American Telephone & Telegraph Company, New York, has submitted the annual report of his company for the year 1910. The development and management of this great organization is of particular interest at the present time, and the report is published quite fully.

The officers of the company and the directors are the following named gentlemen:

President: Theodore N. Vail.

Vice Presidents: Edward J. Hall, U. N. Bethell, William R. Driver, N. C. Kingsbury, B. E. Sunny, H. B. Thayer, Charles P. Ware.

Treasurer: William R. Driver.

Secretary: Charles Eustis Hubbard.

Comptroller: Charles G. DuBois.

General Counsel: George V. Leverett.

Chief Engineer: John J. Carty.

Directors: Charles W. Amory, Thomas B. Bailey, George F. Baker, Francis Blake, Harry H. Brigham, Alexander Cochrane, T. Jefferson Coolidge, Jr., W. Murray Crane, Henry P. Davison, Rudolph Ellis, Norman W. Harris, Henry L. Higginson, Henry S. Howe, Charles Eustis Hubbard, Lewis Cass Ledyard, John J. Mitchell, William Lowell Putnam, Thomas Sanders, Sylvanus L. Schoonmaker, Eugene V. R. Thayer, Theodore N. Vail, Frank E. Warner, John I. Waterbury, Moses Williams, Robert Winsor.

The report begins by presenting a general statement covering the business of the Bell system as a whole, which is as follows:

At the end of the year the number of stations which constituted our system in the United States was 5,882,719, an increase of 740,027. 1,852,051 of these were operated by local, co-operative and rural independent companies or associations having sub-license or connection contracts, so-called connecting Companies.

The total mileage of wire in use for exchange and toll service was 11,642,212 miles, of which 1,162,186 were added during the year. These figures do not include the mileage of wire operated by connecting companies.

Including the traffic over the long-distance lines, but not including connecting companies, the daily average of toll connections was about 602,500, and of exchange connections about 21,681,500, as against corresponding figures in 1909 of 517,000 and 19,925,000; the total daily average for 1910 reaching 22,284,000, or at the rate of about 7,175,448,000 per year.

The amount added to plant and real estate by all the companies, excluding connecting companies, constituting our system in the United States during the year 1910 was:

Real estate	$ 2,518,133
Equipment	19,628,357
Exchange lines	13,409,546
Toll lines	14,959,048
Construction work in process	3,067,734
	$53,582,818

During the year $52,028,000 was applied out of revenue to maintenance and reconstruction purposes.

The total provision for maintenance and reconstruction charged against revenue for the last eight years was over $283,500,000.

Estimates of all the associated operating companies and of the American Telephone and Telegraph Company for all new construction requirements in 1911 have been prepared. It is estimated that about $60,000,000 will be required for current additions to plant in 1911, of which amount some $30,000,000 will be provided by the existing and current resources of the companies.

The question of depreciation has been considered very critically and analytically during the past year, by commissions and other bodies, in connection with studies on the rate question. While a depreciation reserve was generally favored, there seemed to be a disposition to apply experience and theories, gleaned from other lines of business, to the telephone business.

The telephone business is unique in that it supplies its own terminals, which are vast in number, are temporary in character, and call for large investment, unique in that a very considerable part of its plant is of a rapidly deteriorating character. Underground conduits and cables and aerial cables are fast changing this, but in the outlying rural and semi-urban districts and for long-distance lines construction will always have to be overhead on poles. There is nothing analogous to it in industrial or public utility service except the telegraph.

The entire disregard or underestimating of depreciation and future replacement, is the cause of nearly all the financial disasters that have occurred in the telephone business, and has been the common failing of newcomers in the telephone field from the beginning to the present time.

A false atmosphere of prosperity surrounded the business which was not dispelled until replacements of plant through decay or obsolescence became imperative; until the overhead gave way to the underground, until the individual board gave way to the multiple central office system, until central office energy supplanted the magneto system, until exacting construction requirements of long-distance speaking began, until expansion of business and extension into new fields, some unremunerative, were obligatory; until a condition existed where, to correct mistakes of the past, capital had to be expended without producing any corresponding increase in the revenue.

The present policy of the Bell system is to provide against every probable contingency and to base the amount and extent of such provision on past experience—not on future expectations. It is conjectured that the future will show a decrease in the depreciation or reconstruction due to decay, wear and tear, and obsolescence. Changes—improvements—are going on as rapidly as in the past, but the general character of plant and methods is assuming more permanency. The improvements are being evolved from, and are being grafted on to, the old system and methods. The disturbing and sometimes seemingly destructive conditions following the rapid development of high-pressure power and transmission have been to a great measure overcome.

All this has been made possible through the unremitting study and research of the Engineering and Experimental Departments of the Company, who by close attention, observation and study, anticipate and provide for all such contingencies and conditions as can possibly be anticipated or provided for in advance.

Not only must this increase be met, but to be met economically or efficiently, it must be anticipated; subways cannot be built conduit by conduit, or filled wire by wire—cost would be prohibitive and service impossible. Central office buildings must be located and erected and connected by subway with the general system before switchboards or wires or equipment can be introduced. When built they must be built for the future. To build for present requirements only, and enlarge as demand comes, is impossible in much of this work; and, where possible, impracticable from service standpoint, or prohibitive from that of cost. Advance construction of this kind of the Bell Telephone System, including construction in process, December 31, 1910, was estimated at $180,000,000. Had no plant been built in advance of needs except that which was unavoidable the expenditure would have been reduced by $112,000,000, but the cost of the plant not built at first, if provided later and only as required, would have been $25,000,000 instead of $112,000,000. In other words, not to provide for advance construction doubles the cost of the plant.

The gross revenue collected from the public in 1910 for telephone service by the Bell System—not including the connected independent companies—was $165,600,000; an increase of nearly $16,000,000 over last year. Of this, operation consumed $54,000,000; tax-

es, $8,000,000; current maintenance, $25,700,000; and provision for depreciation, $26,200,000.

The surplus available for charges, etc., was $51,000,000, of which $11,550,000 was paid in interest and $25,000,000 was paid in dividends to the public.

The total capitalization, including intercompany items and duplications, of the companies of the Bell System is $1,114,310,979. Of this $502,306,910 is owned and in the treasury of the companies of the Bell System. The capital stock, bonds and notes payable outstanding in the hands of the public at the close of the year were $612,000,000. If to this be added the current accounts payable, $21,700,000, the total obligations of every kind were $633,700,000, as against which there were liquid assets, cash and current accounts receivable, of $53,600,000, leaving $580,100,000 as the net permanent capital obligations of the whole system outstanding in the hands of the public.

Against these obligations, the companies had property $696,700,000—an excess of $116,600,000, or 20 per cent.

There is a large additional surplus, which is legitimate and proper and which could be properly added to the book surplus, representing as it does the value of intangible property, such as franchises, contracts, patents, rights of way, both public and private, which are not carried at any valuation in the book accounts.

In every case where the public authorities have appraised the plant of the companies, the valuation has been far in excess of the book valuation. It is within the bonds of conservatism to say that the obligations of all the companies outstanding in the hands of the public are represented by 150 per cent. of property at a fair replacement valuation of the plants and assets, not including public franchises.

Particular attention, therefore, is invited to the tables herewith, and also to the one showing averages of operating units of associated companies:

AVERAGE OPERATING UNITS OF ASSOCIATED OPERATING COMPANIES, 1895 TO 1910.

(This Table Covers the Companies Owning all the Exchanges and Toll Lines of the Bell Telephone System Except the Long-Distance Lines of American Telephone & Telegraph Company.)

Average per Exchange Station.	1895.	1900.	1905.	1910.
EARNINGS:				
Exchange Service	$ 69.75	$ 44.68	$ 33.31	$ 31.28
Toll Service	11.35	12.60	9.95	9.47
Total	81.10	57.28	43.26	40.75
EXPENSES:				
Operation	29.15	21.62	16.96	15.14
Taxes	2.23	2.37	1.49	2.00
Total	31.38	24.00	18.45	17.14
Balance	49.72	33.28	24.81	23.61
Maintenance and Depreciation	26.20	17.68	13.91	13.46
Net Earnings	23.52	15.60	10.90	10.15
Per Cent Operation Expense to Tel. Earnings	35.9	37.8	39.2	37.2
Per Cent Telephone Expense to Tel. Eearnings	71.0	72.8	74.8	75.1
Per Cent Maintenance and Depreciation to Average Plant, Supplies, etc.	9.1	8.4	8.9	9.5
Per Cent Increase Exchange Stations*	15.7	26.5	24.5	11.8
Per Cent Increase Miles Exchange Wire*	15.9	33.2	27.2	12.0
Per Cent Increase Miles Toll Wire*	21.3	25.2	12.4	11.5
Average Plant Cost per Exchange Station (including Exchange and Toll Construction)	260	199	145	142
Average Cost per Mile of Pole Line (Toll) (Including Wire)	219	348	438	688
Average Cost per Mile of Wire (Toll) (Including Poles)	81	71	62	66
Per Cent Gross Telephone Earnings to Average Plant	33.4	31.7	31.7	29.3
Per Cent Net Profits to Average Capital Stock	10.11	9.44	8.34	8.48
Per Cent Dividends to Average Capital Stock	5.07	6.19	5.75	6.31

*Increase during year shown, over previous year.

BELL TELEPHONE SYSTEM IN UNITED STATES.

Comparison of Earnings and Expenses, 1909 and 1910.

	1909	1910	Increase.
Gross Earnings	$149,914,708	$165,612,881	$15,698,173
Expenses—Operation	49,731,941	54,235,449	4,503,508
Current maintenance	23,723,681	25,763,082	2,039,401
Depreciation	21,115,272	26,264,927	5,149,655
Taxes	6,976,306	8,355,015	1,378,709
Total Expenses	$101,547,200	$114,618,473	$13,071,273
Net Earnings	$ 48,367,508	$ 50,994,408	$ 2,626,900
Deduct Interest	10,221,383	11,556,864	1,335,481
Balance Net Profits	$ 38,146,125	$ 39,437,544	$ 1,291,419
Deduct Dividends Paid	23,910,603	25,160,786	1,250,183
Surplus Earnings	$ 14,235,522	$ 14,276,758	$ 41,236

COMBINED BALANCE SHEET, 1909 AND 1910.

Assets:	Dec. 31, 1909.	Dec. 31,1910.	Increase.
Contracts and Licenses	$ 7,212,781	$ 2,943,381	$ 4,269,400*
Telephone Plant	557,417,146	610,999,964	53,582,818
Supplies, Tools, etc	17,048,196	20,987,551	3,939,355
Receivables	49,744,919	26,077,802	23,667,117*
Cash	32,055,866	27,548,933	4,506,933*
Stocks and Bonds	38,166,284	64,766,089	26,599,805
Total	$701,645,192	$753,323,720	$51,678,528
Liabilities:			
Capital Stock	$352,904,063	$344,645,430	$ 8,258,633*
Funded Debts	187,685,339	224,791,696	37,106,357
Bills Payable	40,721,625	42,566,943	1,845,318
Accounts Payable	24,633,780	21,721,125	2,912,655*
Total Outstanding Obligations	$605,944,807	$633,725,194	$27,780,387
Surplus and Reserves	95,700,385	119,598,526	23,898,141
Total	$701,645,192	$753,323,720	$51,678,528

* Decrease.

It will be noted that there has been a steady decrease both in expenses and revenue per subscriber's station, so that now the average subscriber pays for a higher grade, more comprehensive service, less than half what he paid fifteen years ago for the much less useful service that was then possible.

This reduction in cost of service has made it possible for every one who needs a telephone to have one and to get the great advantage of being within reach of everybody by telephone.

The greatly decreased plant investment per station to which attention was called in the previous annual report has been still further reduced during the year to $142, notwithstanding the extensive additions to toll lines.

There is a steady increase in the proportion of wires underground, which indicates a greater permanence of plant and decreases the maintenance costs. This low cost of plant and this decreasing maintenance cost are only made possible by the central supervision of engineering and manufacturing of the Bell System and the advance construction referred to at length under the head of depreciation.

The percentage of net profits to capital stock, although not so good as in the earlier years of the business, shows for 1910 an improvement over recent years..

WESTERN ELECTRIC COMPANY.

The Western Electric Company occupies a unique position in the manufacturing business. It is in fact the manufacturing department of the Bell System.

To develop efficiency in service it was necessary to control the evolution of apparatus as well as of methods of operation. To control the quality and style of apparatus, to control the improvements which suggested themselves in the course of, and were the outcome of the experimental work and the development and improvement studies and experiments, it was necessary for the Bell System to control the manufacture of equipment and apparatus.

This relation of the Western Electric Company with the Bell System not only eliminated the expense which such companies must incur in the establishment of their business, but also largely reduced the operating or continuing expenses. Its business was either for the Bell Companies, or came to it because of its relation to the Bell Companies. Its manufactured products were made upon advance orders or to fill regular and definite continuing demands. A relatively small merchandise stock had to be carried.

The growth had been so rapid that there had been no time to adjust the business to the changing conditions. It became apparent that some of these condiitons must be changed for the permanent good of the company.

Before instituting any changes an offer was made to the outside shareholders of the Western Electric Company for an exchange or sale of their stock to the American Telephone and Telegraph Company. The offer was considered a liberal one and was accepted by a very large majority of the smaller holders and by a majority of the total shareholdings not held by the American Company.

A definite program of readjustment to new conditions was adopted and has been steadily pushed forward.

Outside lines of manufacture which were not only unprofitable but were absorbing a very large proportion of the capital of the company have been abandoned and the company's energy and efforts concentrated on the manufacture and sale of telephonic apparatus and auxiliary supplies.

The Hawthorne works have been enlarged and the Chicago City Clinton Street and Polk Street properties have been sold at a slight advance over their book values. The company's debt has been funded and it has ample working capital.

The prices charged to the Bell System are lower than the prices charged to other telephone customers. In the year 1910 the rate of gross profit on sales to the Bell System was 7.5 per cent less than on sales to such other customers. This difference was offset by the lower expense in selling to the Bell Companies.

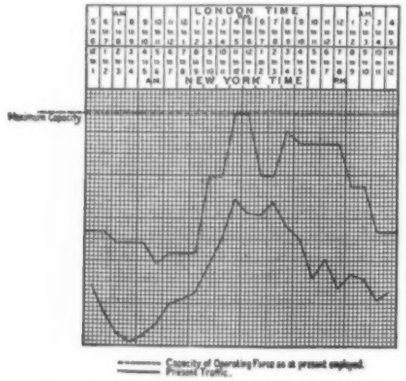
REPORT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The improvement which has marked previous years still continues. The

net revenue for the year was $31,933,-214.49, out of which were paid interest, $5,077,321.33, and dividends, $20,776,-822.12. The balance, $6,079,071.04, shows an increase, notwithstanding the large increase in dividends due to the exchange of convertible bonds for shares. This is comprehensively explained in the report.

Due to conversion of bonds there has been an increase of $6,860,300 in the outstanding share capital. There has been no issue of share capital during the year except in exchange for convertible bonds. The amount of these bonds still outstanding at the time of this report is about $30,000,-000.

The policy of the company in respect to opposition and independent telephone systems has been consistently followed during the year. Wherever it could be legally done, and done with the acquiescence of the public,



TYPICAL WESTERN UNION CABLE TRAFFIC RECORD.

opposition companies have been acquired and merged into the Bell System.

Discussing "Public Relation," the report enters into a rather profound analysis and philosophy. The Bell System gained 740,027 subscribers last year. Of the total number of subscribers over 1,000,000 were new during the year.

The American Telephone & Telegraph Company gained 4,558 shareholders last year. Of the total number of shareholders many more were new last year. This analysis sets forth for the benefit of the new subscribers and shareholders the position of the Bell System.

It is believed that the telephone system should be universal, interdependent and intercommunicating, affording opportunity for any subscriber of any exchange to communicate with any other subscriber of any other exchange within the limits of speaking distance, giving to every subscriber every possible additional facility for annihilating time or distance by use of electrical transmission of intelligence or personal communication. It is believed that some sort of a connection with the telephone system should be within reach of all. It is believed, further, that this idea of universality can be broadened and applied to a universal wire system for the electrical transmission of intelligence (written or personal communication), from every one in every place to every one in every other place, a system as universal and as extensive as the highway system of the country which extends from every man's door to every other man's door.

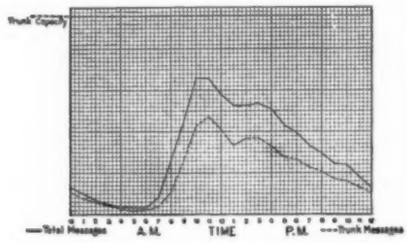
It is not believed that this can be accomplished by separately controlled or distinct systems nor that there can be competition in the accepted sense of competition.

It is believed that all this can be accomplished to the reasonable satisfaction of the public with its acquiescence, under such control and regulation as will afford the public much better service at less cost than any competition or government-owned monopoly could permanently afford and at the same time be self-sustaining.

The report discusses the physical and investment character of the corporate body and takes up the relation between the company and its customers.

PUBLIC CONTROL.

Public control or regulation of Public Service Corporations by permanent commissions, has come and come to stay. Control or regulation exercised through such a body has many advantages over that exercised through regular legislative bodies or com-



TYPICAL WESTERN UNION TELEGRAPH TRAFFIC RECORD AT NEW YORK.

mittees. The permanent commission will be a quasi-judicial body. It should be made up of members whose duty it will be, and who will have the desire, the time and the opportunity, to familiarize themselves with the questions coming before them. It should act only after thorough investigation and be governed by the equities of each case. It would in time establish a course of practice and precedent for the guidance of all concerned.

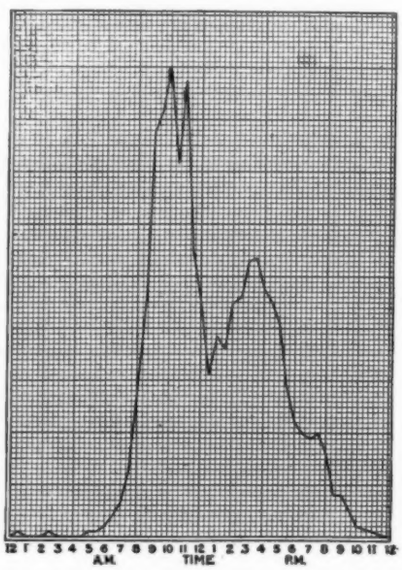
Experience also has demonstrated that this "supervision" should stop at "control" and "regulation" and not "manage," "operate" nor dictate what the management or operation should be beyond the requirements of the greatest efficiency and economy.

Respecting competition versus control or regulation, the many phases of this situation are carefully explained. The inappropriateness of dual service, from the nature of necessary physical relations is emphasized.

Opposition exchanges compete in the same way as do two street railway lines, each starting in the center of the city, running a short distance through the same main street, and then branching off, each supplying an entirely different district of the city. Those traveling only from point to point on the main street can use either line, pay one fare; there is to this extent competition—there is a choice. Beyond that, to reach the other districts, there is no choice, there is no competition; one line or the other must be taken, depending on the particular district wished to be reached.

The relation between the telephone and telegraph service is discussed in detail, and the improvement which may come about through establishing a proper distribution of the complementary features of these services, so that the public may secure every possible facility, is pointed out.

Under a universal wire system operated on the lines and in the manner indicated above, the additional services will be given to the public at rates commensurate with the value of such services, and in the great possibilities of electrical transmission of in-



TYPICAL LONG-DISTANCE TELEPHONE TRAFFIC RECORD.

telligence some uses will be found or developed to absorb and utilize this enormous waste, and also relieve any congestion now suffered by the more important business by furnishing a service which would be satisfactory to such of the existing business as has heretofore had no alternative, but would prefer the new service.

The Night Letter—the first attempt—met with popular reception and is filling a definite place in the business and social world. The Day Letter, so recently introduced that its possibilities cannot yet be determined, will doubtless find its place. Depending upon the reception of these, other services will be introduced.

It is also intended to extend some of these new classes of service to the transatlantic cables as soon as it is made possible by the completion of negotiations and arrangements now pending.

The report concludes with a summary of some of the principal things shown in this and previous reports.

It is shown that the total outstanding obligations of the Bell System in the United States, not including the manufacturing company, amount to $580,000,000. All the capital of the various companies composing the

System not included in this consists of intercompany items and duplications.

It is shown that the book value of the property representing these outstanding obligations is $696,700,000, $116,000,000 in excess of the outstanding obligations.

It is shown that the construction costs of the Bell System are small. The cost per exchange station is but $112.17. The cost for exchange station, including the extensive system of toll lines, is but $142.13.

It is shown that the cost of construction per exchange station has steadily decreased from $199.00 in 1900 to $142.00 in 1910, notwithstanding the great increase in the investment in real estate, underground construction, toll-line construction and copper wire.

It is shown that instead of increasing and oppressive rates there has been a continual decrease of the average annual charge for exchange service from an average of $44.68 in 1900 to $31.28 in 1910.

It is shown that the taxes paid in the year 1910 by the Bell system amount to over five per cent of its gross earnings, 16.4 per cent of its net earnings, and 1.4 per cent of the value of its telephone plant.

It is shown that the control of the company is not vested in any one interest nor has it been used for the benefit of any individual or group of individuals.

It is shown that the American Telephone and Telegraph Company is not in the accepted sense a trust nor has it been built up by absorbing competing companies or in restraint of business.

It is shown that physical connection does not and cannot bring about any economical or beneficial result and increases instead of decreases the evil of dual construction and subscription.

That physical connection would give to subscribers of an opposition exchange the service and use of property provided for the use of others, and for which others pay.

We are charged with making abnormal profits on the equipment, supplies, etc., furnished the operating companies by the Western Electric Company, and in this way increasing the cost of service to the public. It is shown that the profits on Western Electric sales to the operating companies of the Bell System are less than on sales to the independent companies, to the extent at least of the saving in the cost of selling to the operating companies.

It is also shown that the telephone service and the telegraph service are complementary, not competitive; that each has its own proper place; that joint use and joint occupancy of wires will reduce operating cost, maintenance charges and construction investment. That utilizing the unutilized facilities of both will make possible large economies and improvement in the wire service as well as new, additional and useful services of both telephone and telegraph, for the benefit of both the corporations and the public.

Life of Primary Batteries.

A paper giving the results of some investigations carried out in connection with the ordinary types of signalling batteries used by the British Post Office and other telephone administrations, was recently read by J. G. Lucas, at a meeting of the Institution of Post Office Electrical Engineers, London. Referring first to the porous-pot Leclanché type of cell, text-books were, the author stated, very much out of date on this question and pointed out that modern telephone requirements could be met much more economically by modifying the sub-division of the manganese dioxide and carbon in the porous pots. In the case of even such small current discharge rates as forty milliamperes the result of the modifications was to decrease the total working costs considerable, while at discharge rates higher than forty milliamperes the decrease in costs was much greater. The agglomerate form of Leclanché battery was an expensive type, and the possible advantages which might be derived from its use were not, he considered, commensurate with this expense.

Investigations with dry cells as at present designed went to show that the chief difficulties and expense lay in the fact that for discharges which must necessarily be spread over several months full use could not be made of the chemical energy contained in the materials used in these cells owing to the sudden rise, after a time, in the internal resistance. The behavior of experimental cells indicated that the difficulties were not insuperable.

The free ammonia gas evolved from Leclanché cells has been found to seriously affect the metal work of telephones and to act deleteriously upon secondary cells. To overcome this objection experiments had been conducted with an electrolyte of manganese chloride instead of the usual ammonium-chloride solution with satisfactory results. The author pointed out the practicability of sealing up the battery compartments in connection with cells charged with managanese-chloride solutions and the consequent reduction in loss by evaporation as compared with ammonium chloride.—*The Mechanical Engineer.*

Wireless Men Reindicted.

Another indictment has been returned by the federal grand jury against the officials of the United Wireless Telegraph Company, in which a scheme to defraud by means of the United States mails is charged.

The new indictment charges a conspiracy to defraud as well as a violation of the postal laws, and names as defendants Col. Christopher Columbus Wilson, the president of the Company; Samuel S. Bogart, the vice-president; William W. Tompkins, Francis H. Butler, William A. Deboil, Charles C. Galbraith, and George H. Parker.

German Cable to South America.

The cable ship Stephan has entered upon the laying of the German submarine cable which is to traverse the narrowest part of the Atlantic, connecting Monrovia, Liberia, with Pernambuco, Brazil.

Some obstacles in the way of prior concessions seem to stand in the way of immediate extension of branch lines north and south from Perambuco, and the gaining of an entrance into Rio de Janeiro appears to present particular difficulties. For these reasons it is probable that for some time after the trans-Atlantic line is in operation messages for other points than Perambuco will be forwarded under contract over the lines of other companies. It is understood to be the ultimate intention of the German company, however, to secure entrance for cable lines at all of the important points along the eastern coast of South America as far south as Montevideo and Buenos Aires.

Wire Companies Increase Southern Forces.

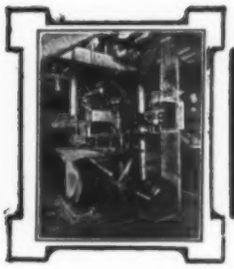
In order to take care of the great amount of telegraph business occasioned by the revolution in Mexico, the Western Union Telegraph Company has increased its force in San Antonio and Galveston and will probably send men to other southern cities. The Postal Telegraph Company has also increased its forces

Interstate Commerce Commission to Define Its Relation to Telephone Companies.

A recent report from Washington states that the Interstate Commerce Commission will in a short time issue a statement defining its power over the telephone and telegraph companies. In this statement the Commission will probably tell how far the new Interstate Commerce law applies to these companies and whether it will be necessary for them to file their tariffs of rates and charges and regulations or not, and if so, in what manner.

A High Antenna Mast.

The Marconi Wireless Telegraph Company has erected a steel pole and wooden mast, together 210 feet in height, close to their works at Chelmsford, England, to be used for experimental work in connection with high-power currents.



Industrial Power

Electrical Power in an Artificial Ice Plant.

In the manufacture of artificial ice it is necessary to produce a sufficiently low temperature to freeze the water. To obtain this, the Crystal Ice & Storage Company, of Buffalo, N. Y., utilize the principle of the rapid absorption of heat by the evaporation of liquid ammonia. A long tank is divided into compartments by plates 15.5 feet long and 9.5 feet wide. Between each two compartments there are two plates spaced a sufficient distance apart to admit a system of coils for conveying the liquid ammonia being placed there in contact with both plates. Spring water is placed in the compartments and the evaporation of the liquid ammonia extracts heat from the water in contact with the plates, causing ice to form on them. The ice is allowed to get twelve inches thick before harvesting. There are sixteen tanks in use, each containing plates for eight cakes of ice.

In order that the ammonia may be used again and again after evaporation, it is liquified by a double cylinder compressor which is driven by a 200-horsepower 2,200-volt induction motor by means of a rope drive.

To produce ice free from air bubbles, the water in contact with the freezing plates is agitated by means of compressed air admitted from a perforated pipe placed near the bottom of the tank. The circulation produced by the air bubbles floating upward through the water assists in removing the impurities and air bubbles from the surface of the ice. To facilitate handling the large cakes, which, when twelve inches thick, weigh about 9,400 pounds, two eyebolts are frozen into each cake of ice.

When the cake is up to the desired thickness hot ammonia gas is sent through the pipe system loosening the cake from the plate.

The tanks are arranged in two rows, each served by a seven-ton crane. Each crane is operated by two induction motors of five and three horsepower capacity respectively, and of the slip-ring type as they are required to start under load. These remove the cake of ice from the tank and carry it to the tipping table.

After the cake is placed on the tipping table, the bolts are removed by applying a heavy current of electricity to the rods. The projecting terminals at the lower end of the bolts are connected together by means of a flexible copper cable and voltage is applied to the upper ends. A specially wound type H transformer is used for this purpose, rated one kilowatt at four volts on the secondary. The 250-ampere current hus obtained will loosen the bolts in about one minute.

The tipping table is operated by a two-horsepower motor wired for reverse operation as well as direct to allow a range of motion of the table through nearly 180 degrees, permitting placing the cake with its flat side, *i. e.*, the side which was next to the freezing plate down, regardless of its position when removed from the tank.

For distribution to customers the cake is now cut into smaller cakes by a motor-operated saw. This saw is in most cases mounted on a revolving stand and traveler, so arranged that a cut may be made either sidewise or lengthwise of the cake. The motor speed is 1,500 revolutions per minute and it drives the saw at a speed of about 1,200 revolutions per minute.

The panel for controlling this power is equipped with a polyphase indicating wattmeter, a polyphase recording watt-hour meter, and an automatic oil switch provided with both overload and low-voltage release coils. Air-break switches are installed in the incoming lines so that the panel may be isolated in case it is desired to inspect the panel equipment.

Another panel controls a 200-horsepower induction motor driving the ammonia compressor and is equipped with a 200-ampere ammeter and a 100-ampere oil switch with series overload coils.

The Crystal Ice & Storage Company purchases its power from the Cataract Power Company, who act as local distributing agent for the Niagara Falls Power Company.

But two men are required to handle the entire output of this plant from the freezing tanks to the loading platform. The average daily production is about seventy-eight tons, although during the hot weather the output sometimes runs as high as 100 tons per day.

The building is lighted throughout by Mazda lamps of the 60 and 100-watt sizes.

Owing to the magnitude of the electric power schemes which have been developed at Niagara Falls, low rates for electrical energy prevail in this vicinity. Buffalo enjoys a low rate because it is within this zone of distribution and uses a large amount of power in the many industrial plants located there. The entire electrical equipment, including induction motors, transformers, switchboard panels and controlling apparatus, was furnished by the General Electric Company, Schenectady, N. Y.

Electrical Equipment for Shipyard.

The shipbuilding firm of Simons & Company, at Renfrew, England, has had its entire works equipped with electrical power. Central-station supply is purchased at high tension, and a substation on the grounds contains the transformers, motor-generators and air compressors. The latter supply the pneumatic tools.

There are two switchboards, distributing alternating and continuous current respectively, motors for both systems being installed in connection with the main drives of the shipyard, engineering, and other shops. In the building yard all the hoists, including the various winches, are electrically driven.

The Distribution of Electric Power.

The question before the power-user of today is not the desirability of using electricity, but rather the sources from which it shall be obtained. The usual alternatives will be between installing generating plant for himself, or purchasing power from the public mains. Where the latter are supplied by a comparatively small company, he may, if his requirements are large enough, possibly find it preferable to install plant for himself. But in the case of users situated within the area of one of the large power companies, a careful and unbiased comparison of the two cases, taking all the conditions into account, usually shows that in this, as in other branches of modern life, it is economically more sound to deal with the large central producer—the specialist in power production—with all his advantages for producing cheaply, than to build a small and, by comparison with these great central stations, inefficient separate station.

The advantage which a mill-owner or colliery manager or shipbuilder derives from co-operating with a power company is, moreover, not confined to a saving in the cost of power. When himself setting up as a producer of electric power, he must, to do the job properly, spend both money and time (which could often be more profitably spent upon his own work) upon a business of which he and his manager can hardly have special knowledge—a highly specialized business, which is yearly becoming more technical and complex. He may call in an expert, but the experts who are unconnected with manufacturing companies, quite impartial, and with an experience equal to that of the power companies, are few and difficult to find. In fact, it has been demonstrated over and over again that from every point of view the co-operation of the two parties is economically desirable and scientifically sound.

This saving in initial and annual costs resulting from co-operation equally applies in the case of the largest consumers, such as railway companies, tramways, and municipal lighting undertakings, all which are nowadays to be found taking their supplies from central power companies. It is only a question of the central system being sufficiently larger than the consumer; and it not infrequently happens that by co-operating with the central system the large power-user gains even more than the small ones. This particularly applies, paradoxically enough, to those cases where the power-user already has an independent source of power, such as coke-oven or blast-furnace gas, or exhaust steam from blowing or winding-engines. In all these cases, and under almost all conditions, the maximum profit in the long run can be obtained by co-operation between the two parties. By himself, the owner of the waste energy can never find a consumer whose demands exactly coincide both as to time and place with the production of waste power.

While a portion of the surplus power can generally be utilized on the spot, there are always times when no use can be made of it locally, and for the owner to store it or transmit it to neighboring towns is, of course, impracticable. A power company, on the other hand, has a sufficient variety of consumers connected to its mains to make use of the power produced night and day, and a system of mains by which the power can be transmitted to whatever point in its area power is needed at the moment. In addition, the power-user working in co-operation with the power company is independent of the shutting down of his power plant due to accidents, strikes, or variations in the output of coal, coke, or iron, or whatever he is producing due to trade conditions. By forming part of the general power system of the district he has available at all times of the day or night a supply of power for all his purposes and as a stand-by to his own installation, while any surplus of power which he produces the power company is willing enough to purchase. For the waste-heat owner needing a reliable supply the only practicable alternative to joining up with a power company's mains is the erecting of a complete installation of "stand-by" plant, and arrangement more costly than purchasing power from outside.—*Engineering.*

Electric Ship-Propulsion in Scotland.

A vessel has been built in Dumbarton, Scotland, which will be electrically propelled, the power being generated by a four-cylinder Crossley gas engine, using producer gas. It is rated at forty-five horsepower.

A Gas-Engine and Steam-Turbine Plant.

One of the interesting features of a plant which is in operation at the Lens mining and metallurgical establishment in the north of France is the great variety of methods which are used for generating power.

In the case of the steam groups, steam is furnished by boilers which are adapted for burning coal, while other types of boilers are operated by gas from the coke ovens. Steam engines are used for some of the groups, but steam turbines are also employed, and several different systems, such as the Brown-Boveri, Rateau and Curtis figure among the groups. Again we find the coke oven gas used directly with gas engines which are designed to run on this kind of gas. Thus there is a considerable output from all these groups taken together. Current is used in the plant for many different purposes, and there are blowers for the blast furnaces, pumps of various kinds, cable hoists for the mine shafts; and an extensive outside power network is also supplied from this source. On this system there are about 230 motors, representing 9,000 horsepower.

High pressure steam for the turbines is obtained from boilers which burn coal or coke-oven gas. Other boilers burning one or the other of these fuels are used to deliver low-pressure steam for the non-condensing engines of the cable drums, using extra steam chambers in this latter case to equalize the pressure. The engine-dynamo sets which use coke-oven gas have a considerable interest. The engines are built by the Augsburg-Nuremberg Machine Company, and there are at present three 1,000-horsepower groups erected in the plant. The gas comes from two batteries of coke ovens, the first containing 140 ovens and the second 160 ovens. It is passed through scrubbers and other apparatus before delivering to the engine. These latter are of the two-cylinder tandem type and are operated at 107 revolutions per minute. They are direct coupled to French-built Westinghouse alternators, working at 5,000 volts, three-phase at fifty cycles.

Electricity in Indian Mines.

Electricity has been introduced into thirteen groups of coal mines in India, according to the report of the chief inspector of mines.

New Electrical and Mechanical Apparatus and Appliances.

Rotary Converters.

The limitations of economic transmission of direct current necessitate either close proximity of the generator to the point of power application, or introduction of alternating current for generation and transmission. Today the two distinct systems for electrical distribution are often combined to great advantage by means of apparatus for transforming alternating into direct current. For such service the Westinghouse Electric & Manufacturing Company has, during the past few years, developed a complete line of rotary converters. The Westinghouse rotaries of the new standard line are all self-starting.

The combined efficiency of a rotary converter and transformers will usually be somewhat higher at all loads than the efficiency of a motor-generator set of equal capacity and voltage. Practically all large systems requiring change from alternating to direct current for railway or power service have adopted conversion by rotaries on account of their simplicity and compactness.

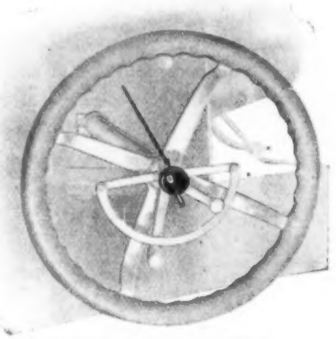
WESTINGHOUSE ROTARY CONVERTER.

They are built in all sizes, from small machines used in the laboratory for demonstration purposes, up to units of 3,000-kilowatts capacity. They are arranged for standard frequencies and voltages.

The total estimated capacity of Westinghouse rotaries now in satisfactory operation in all parts of the world amounts to more than 1,000,000 kilowatts.

New Type Steering-Wheel Switch.

The Connecticut Telephone & Electric Company, Meriden, Conn., has just placed upon the market a new form of steering-wheel switch. This device is mounted in the center of the steering wheel and wire connections run through a tube in the steering column.



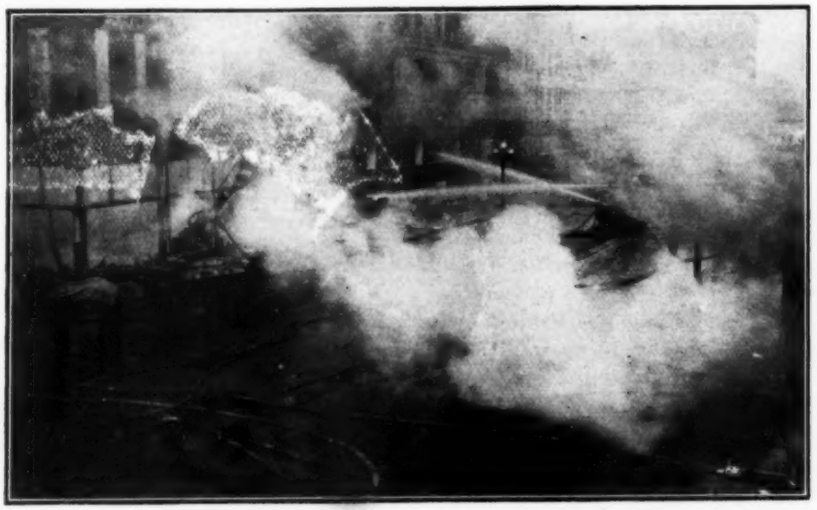
STEERING-WHEEL SWITCH.

This allows a perfect control of the battery and magneto circuits right under the thumb of the operator and in connection with the spark and gas levers. The first position of the switch is "Off"; the next position throws the coil or battery into operation; the second position throws the coil and battery together sparking simultaneously in each of the cylinders; the third position throws the magneto only into circuit. Shooting the battery and magneto together in each of the cylinders slightly increases the engine power.

Its value will be recognized, however, in its control, particularly in connection with a magneto which does not allow the car to throttle down slowly in crowded traffic. The coil and magneto can then be used together. This switch has been adopted by several well-known cars for the 1911 season. The lever or handle of this switch is removable and therefore serves as a lock for the switch.

Fire-Proof Lamp Standards.

The accompanying illustration affords a very interesting demonstration of the fire-resisting qualities of iron lamp-posts. On the morning of Monday, March 6, a conflagration swept one of the business blocks of Minneapolis, Minn., and so fierce was the blaze that the fire threatened to become general. As a matter of fact damage to the extent of nearly a million and a half dollars was done before the flames were checked. The incandescent lamp standards were located entirely round the block which was the central location of the fire, and notwithstanding the extreme heat, they stood up without distortion or damage of any kind.



SCENE DURING MINNEAPOLIS FIRE SHOWING UNHARMED LAMP STANDARDS.

These posts were furnished by the Flour City Ornamental Iron Works of Minneapolis. They are what is called

the "Corinthian Standard," and in their construction only pig iron is used. They are solid castings and the long experience of the company has developed a system of casting which has made it possible to produce not only a durable post but one in which the elements of artistic beauty are a commendable feature. These posts have been installed in a number of other progressive cities in the United States and Canada, notably at Duluth, Atlanta, Milwaukee, Fort Dodge, Sioux Falls, Toronto and Calgary.

Students Inspect Triumph Factory.

A delegation of third year students from The Kentucky State University, Lexington, Ky., visited the plant of The Triumph Electric & Ice Machine Company, on March 15, and were conducted through the plant by employees who explained the various methods of manufacture.

TYPE OF STREET-LIGHTING STANDARD THAT WITHSTOOD SEVERE TEST.

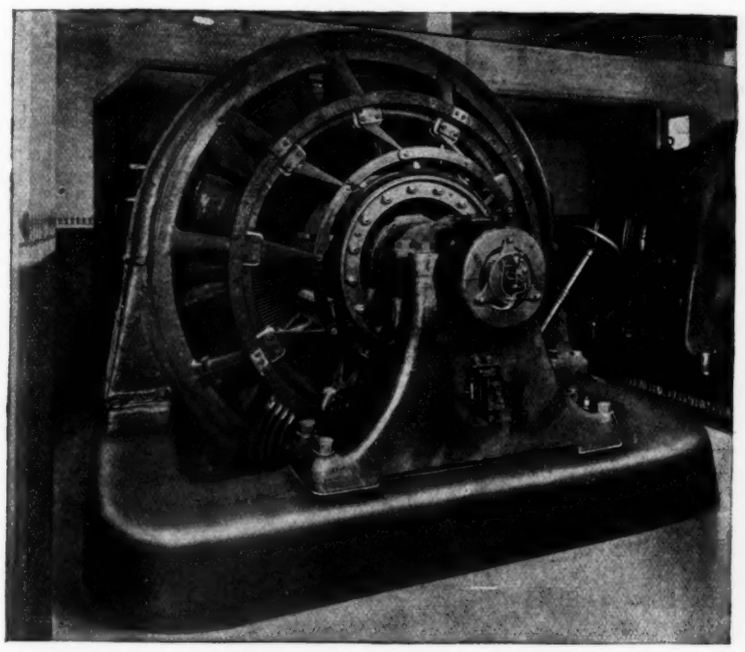
The visitors were particularly interested in machine-tool design and had selected The Triumph Company as part of their itinerary on account of the modern and up-to-date equipment employed in these shops.

Regulating-Pole Rotary Converters.

Rotary converters are often installed where the service requires a variable ratio between the alternating current and direct current voltage in order to meet conditions which arise in the modern complex distribution systems. The Potomac Power Company, of Washington, D. C., has found it necessary to install rotaries of this type and has solved the problem by the use of the General Electric Company's new regulating-pole rotary converters. These accomplish the voltage regulation in a very simple manner without the use of complicated apparatus or wiring. They are provided with auxiliary regulating poles which are so set that one regulating pole adds its flux to that of a main pole, either increasing or decreasing it, and so increasing or decreasing the direct-current voltage. The current in the regulating pole circuit is varied by means of a rheostat inserted in this circuit.

Five of these rotaries, each having a capacity of 1,000 kilowatts, have been installed by the Potomac Power Company, three of which are used in railway work, for supplying current to the Washington Railway & Electric Company, and give a variation in voltage of from 515 to 600 volts. By means of these any desired subdivision of load between the various substations of the railway company can be obtained, as by increasing the potential at which the power is supplied by a substation, other conditions remaining the same, its load may be increased, and by reducing the potential its load may be diminished. These machines have the usual shunt and series winding on the main pole and a shunt winding on the regulating pole. The field winding on the main pole gives the usual compounding at any voltage to which the machine is adjusted by the rheostat in the regulating pole circuit.

The other two converters are used for lighting and permit the potential to be varied from 240 to 300 volts. They have a shunt winding on both main and regulating poles. These machines have been in constant service for nearly two years and the results of their operation have been highly satisfactory.



REGULATING-POLE ROTARY CONVERTER.

New Italian Lamp Factory.

A branch of the Compagnie Generale d'Electricite de Paris is being built in Milan, Italy, and when in running order will manufacture about 6,000 incandescent metallic-filament lamps daily.

The Westinghouse interests are in a very prosperous condition at the present time, and the operations at the various factories and shops indicate strongly that the current year will be recorded as one of the most flourishing in the history of these corporations.

Large Stoker Installations.

The Hartford Electric Light Company of Hartford, Conn., has just completed the installation at its Dutch Point station of what are, as far as is known, the largest automatic stokers ever built. These are two fourteen-retort Taylor gravity underfeed stokers, which were built by the American Ship Windlass Company, Providence, R. I., and fire two 1,250 horsepower Bigelow-Hornsby boilers. Two other boilers of the same size which have been in operation for some time fired by hand are also being equipped with Taylor stokers, so that the total horsepower of the stoker battery will be 5,000 boiler horsepower divided into only four units.

In this type of stoker the coal, which is fed into a hopper on the boiler front, is pushed out underneath the fire by means of automatic rams and at the same time is carried downward by the steep slope of the grate. The forced draft is supplied at a pressure of about four inches by three Sturtevant blowers, engine driven, which discharge into ducts supplying all the boilers. Because of the underfeeding feature smokelessness is a peculiar attribute of these stokers, the hydro-carbons being distilled off and passing through the hottest part of the fire before the green coal itself arrives at the temperature of ignition. This coking process, together with the automatic air control which insures sufficient oxygen for combustion at all loads, results in smokeless combustion and at the same time a very high boiler efficiency.

Extremely large overloads have been carried on stokers of this type and it will be interesting to note what will be accomplished in this line in the present installation. The exceedingly large size of these units is due to the desire on the part of the management to bring about an economy of labor as well as economy of space. Instead of twelve men per twenty-four hours to a battery of 2,500 horsepower as was the case with hand firing, the stokers handle the same boiler capacity with three men per day, one man for each shift of eight hours—a striking tribute to the economy of labor obtained with automatic stokers in large units.

Another interesting installation of stokers is in the new power station of the Boston Elevated Railway which is under way at South Boston, Mass., and will be equipped with Babcock & Wilcox 600-horsepower boilers fired by Taylor gravity underfeed stokers. The engineers for the new station, Messrs. Stone & Webster, have recently ordered from the American Ship Windlass Company, sixteen seven-retort stokers to be used in this station. The choice of stokers was decided upon only after extensive experiments by the Railway Company, extending over the last four years.

The boiler-feed pump installation is to consist of two six-inch four-stage Jeanesville pumps with a capacity of 1,000 gallons per minute and one four-inch four-stage Jeanesville pump with a capacity of 500 gallons per minute. The two larger pumps are to be driven by two 225-horsepower Terry steam turbines at a speed of 1,800 revolutions per minute while the smaller pump will also be driven by a Terry turbine of 125 horsepower. The speed of the latter is 2,400 revolutions per minute. A feature of the design of this station is the extensive use of turbine-driven centrifugal pumps. Not only are the boiler feed units of this type but Terry-Jeanesville units have also been ordered for underwriter fire service, low-pressure station water sevice and for circulating condenser water.

LARGE STOKER INSTALLATION.

Portable Telephone Sets.

With the spread of telephone train dispatching among the railroads in this country, a piece of apparatus has come into extensive use on such lines, and every day sees its adoption to a greater extent. This is the portable telephone set.

FIG. 1.—NO. 1330 SET EQUIPPED WITH FIVE-BAR GENERATOR.

FIG. 2.—NO. 1332 SET.

FIG. 3.—NO. 1331 SET, CLOSED.

This set is being used by officials in their private cars, inspectors who have to cover the line, train crews, and construction, bridge and wrecking gangs.

The advantages of the portable telephone set are striking. Communication can be established immediately between a distant point and headquarters by means of such a set carried on trains, and connected to the telephone train wires by means of a line pole. In cases of emergency, this one feature has more than paid for the total cost of the installation of the telephone cir-

cuit. Delays to traffic are reckoned in dollars and cents, and on important lines, such delays are tremendously expensive. With a telephone at hand, and the conductor or someone else able to give headquarters detailed advice in regard to conditions on the spot, hours are frequently saved.

Three of the sets in general use among the railroads are those manufactured by the Western Electric Company and known as the Nos. 1330, 1331 and 1332 types. The first named is declared by the manufacturers to be the most efficient set on the market today. It is equipped with a powerful five-bar generator and finished with a special weatherproofed varnish. The construction is of the strongest throughout, and the corners are reinforced with steel. The hand set in this particular case is attached to a six-foot cord so that the user may stand upright when the set is on the ground, and a push-button is provided in this hand set so that the transmitter circuit is closed only when desired. The No. 1331 set is of similar design, but equipped with a three-bar generator. The No. 1332 set is for use on train wires where the dispatcher is at all times connected with the circuit, and it has no generator.

Many of the roads are equipping every train on their line with these sets, and their use on wreckers is very general. In some cases the portable telephone set is made part of the standard equipment of the engine.

Thermit Welding at Chemical Society.

The Cleveland Branch of the American Chemical Society at its March meeting was addressed by W. R. Hulbert, manager of sales, Goldschmidt Thermit Company, on the Thermit welding process.

In addition to a general description of the process and its various applications, with lantern slides, Mr. Hulbert gave a demonstration of Thermit welding, comprising a number of experiments to show how the process is used commercially for repairing wrought-iron and steel sections, and for welding pipes up to four inches in diameter.

Much interest was shown in the demonstration, which was witnessed not only by the local members of the American Chemical Society, but by members of the American Society of Mechanical Engineers and others.

New Controllers for Motor-Driven Printing Presses.

Manually operated printing-press controllers have been giving way in recent years to the magnetically operated controller by which all the refinements of control and adjustments of the press

FIG. 2.—LEVER-TYPE CONTROL SWITCH.

can be accomplished with greater ease and precision. The illustration Fig. 1, shows one of a new line developed by the Cutler-Hammer Manufacturing Company, of Milwaukee. This controller built in sizes for use with direct-current motors of from 1 to 7.5 horsepower and particularly adapted to flat-bed press control, gives a speed reduction of fifty per cent below normal speed by armature resistance and an increase up to 2 to 1 by shunt field resistance. The motor circuit is always made and broken by a solenoid switch.

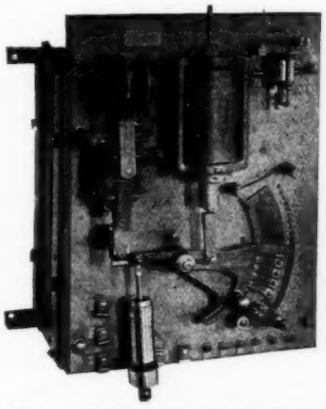


FIG. 1.—NEW CUTLER-HAMMER CONTROLLER.

The controller lever is divided into two parts, the rheostat arm carrying the brushes for the armature, and field resistance contacts; and the operating arm connected to the oil dash-pot and the solenoid plunger. The operating arm moves the rheostat arm by means of a pin which may be set in any one of a series of holes in the rheostat arm. In this way it is possible to adjust the movement of the rheostat arm and therefore, the speed to which the motor will be brought by the self starter. Adjustments are provided in the rheostat arm so that it may be left continuously on any of the armature or field contacts. It is thus possible to adjust the printing speed and the press will always be brought to this speed.

The control switch, Fig. 2, is of the lever type inclosed in a substantial metal case. A centering spring holds the lever in the "ready" position. Moving the lever to the left stops the motor, and if the lever is locked in this position by a latch provided for that purpose, it is not possible to start the press from any point. This is the "safe" position. Moving the lever from the "ready" position one step to the right, closes the main line solenoid switch and starts the motor. If the lever is then returned to the "ready" position, the motor will continue to run slow. Moving the lever to the extreme right energizes the self-starter magnet and the motor is automatically accelerated to the printing speed.

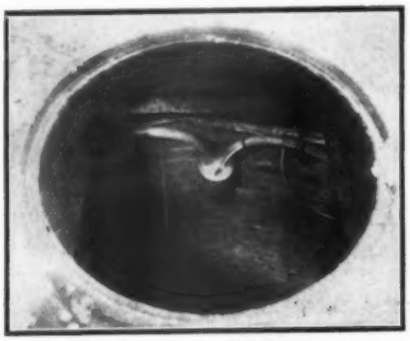
Daylight Shops.

A new type of window-sash has been devised for use in industrial buildings and railway shops, which does away with heavy wooden frames and mullions, and makes it possible to utilize nearly the total window opening for light. This sash is of very simple but strong construction, offers nothing which will be destroyed by fire, and is amply strong to withstand wind pressure. It is made of steel bars rolled into sections. A small slot is made in the vertical bar of the sash, which is made just large enough to admit the flange of the horizontal bar. The moulded part of the vertical bar is pressed out so that it will fold closely around the moulded portion of the horizontal bar. A notch is cut in the horizontal bar to act as a lock. It is evident that the amount of metal cut away in construction of this joint is very little. The bars run continuously from the top and the bottom of the sash.

In the shop of the New York Central Lines at West Albany, N. Y., equipped with metal window-sash, the windows provide nearly the whole side of the shop of glass. There are twenty-seven windows in all, containing 12,828 panes of glass. This sash is known as the "Fenestra" window-sash. It is patented and manufactured by the Detroit Steel Products Company, Detroit, Mich.

Extensive Installation of Matthews Cable-Splicing Joints.

One of the most acceptable and popular mechanical improvements in line construction work that has been placed on the market for many years is the Matthews cable-splicing joint. This joint is well known to linemen and



INSTALLATION OF MATTHEWS' CABLE-SPLICING JOINT.

construction men all over the country, and among the very large users of this material are the fire-alarm and police-telegraph systems of the large cities. The accompanying illustrations show some installations of Matthews cable-splicing joints used by the city of Detroit in connection with its fire-alarm telegraph system. Louis Gascoigne, superintendent of fire-alarm telegraphs of Detroit, has installed over 500 No. 2 and No. 3 Matthews cable-splicing joints and he is an enthusiastic believer in this material. A recent letter from him states: "We have made use of the Matthews cable-splicing joint exclusively for underground work on fire-alarm cables from the time that

INSTALLATION IN DETROIT MANHOLE.

they were first placed on the market, and we have never had a case of trouble in them."

While this joint is highly endorsed by expert cable splicers, one of the features which has made it so popular is that it does not require an expert splicer to install it in the circuit. Any telephone man can learn how to put one in correctly after a careful reading of instructions and an hour's practice with the use of lead and paraffin and it is also a highly desirable utility for overhead circuits. These joints are manufactured by W. N. Matthews & Brother, 209 North Second Street St. Louis, Mo.

Westinghouse Company's Business.

The month of February of this year is reported to have been the best February in the history of the Westinghouse Electric & Manufacturing Company. It is expected, however, that the business done during the current month will fall slightly under that done in March, 1910, when the company was doing a gross business of approximately $3,000,000 per month.

A Handy Wire Skinner.

To remove the insulation from a wire by the aid of only a knife requires considerable skill on the part of a

FIG. 1.

wireman if the conductor is not to be injured nor too much time consumed in the operation. Electricians have generally felt the need of a handy tool to facilitate this work.

The P. & G. Wire Skinner has recently been invented by some practical Chicago man to meet this need. As

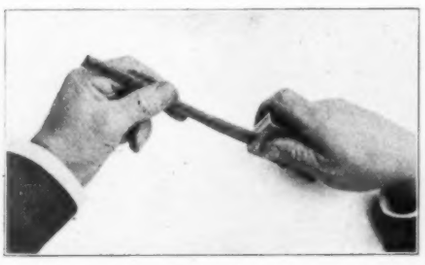


FIG. 2.

shown in Fig. 1 of the accomanying illustrations, this little tool is provided with a pair of spring jaws having several sets of teeth and scrapers. Fig. 2 shows how a twin wire can be split exactly in the middle by a single pull, thus cutting the outer braid but leaving the braid on the inner wires intact. With the middle teeth, as in Fig. 3, the insulation on any single wire can be quickly split for any desired length without trace of injury to the wire. The insulation is readily removed by means of the scraper part of the tool, as shown in Fig. 4.

For lamp cord the tool has been found particularly useful since it removes both the braid and insulation at

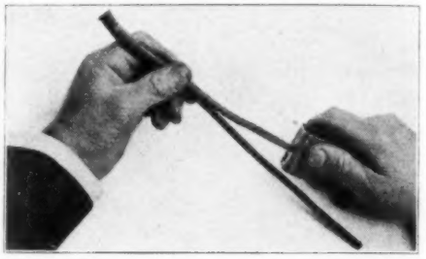


FIG. 3.

one pull without marring a single strand. The tool is serviceable for all wires that a wireman has to handle, from the smallest up to No. 4 B & S, whether single or stranded.

The tool is of pocket side, three and one-half inches long by one and one-half inches wide, and is neatly nickel finished. It is manufactured by the Electric Tool Company, 4016 North Paulina Street, Chicago.

Electrical Equipment for New York Central.

The New York Central & Hudson River Railroad has ordered apparatus from the General Electric Company for the extension of its electrification work on the Hudson River division to Irvington as follows: Four 2,000-kilo-

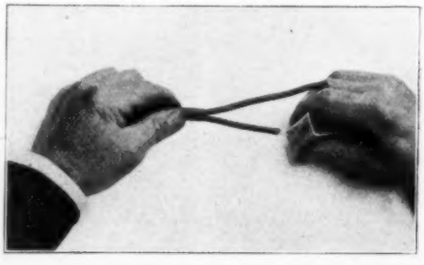


FIG. 4.

watt rotary converters of the commutating-pole type, twelve 735-kilowatt 11,000 volt transformers, two 20,000-cubic-feet-per-minute blower sets. Three of these rotaries with their step-down transformers and the blowers will be installed in the new substation.

Current Electrical News

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

In an important opinion affecting the public utility law, the Supreme Court of Wisconsin recently upheld the virtual abrogation of a contract between the city of LaCrosse and the LaCrosse Gas & Electric Company, by which the Company was to pay the city two per cent of its gross earnings under the terms of its franchise granted by the city. The company had taken out an indeterminate permit from the Commission in 1908 and after that refused to continue paying the tax to the city. An important question as to the effect of the public utilities law of 1907 was decided in this case. The law provides that any public utility which had received a franchise from a city authorizing it to furnish or sell light, heat, water or power might at any time before July 1, 1908, surrender its franchise and receive in lieu thereof a permit to do the same business with no limitations as to time, but subject to the conditions of the utilities law and subject to the right of the city to buy the plant at any time at a compensation to be fixed by the Railroad Commission. It appeared in this case that the city of LaCrosse in November, 1901, granted a franchise to the La Crosse Gas & Electric Company authorizing it to furnish light, heat and power in that city for twenty-five years providing that it paid two per cent of its gross earnings into the city treasury annually. The company after surrendering the city franchise and after taking out the indeterminate permit from the Commission, contended that the conditions of the city franchise had been wiped out and therefore refused to pay the tax any longer. The Supreme Court on appeal affirmed the verdict of the lower court and held that the company need not pay the tax.

The Eagle River Light and Power Company has been authorized by the Commission to discontinue its present flat rate of $2.50 per consumer per month and to substitute therefor a schedule of flat rates based upon the class of service and the size of installation. The new rates will bring no increase in total revenue to the company but they will eliminate to a large extent the many discriminations which have hitherto existed. Analysis of the financial conditions of the company showed that the present revenues of the company are not adequate to provide for depreciation and a reasonable return on the physical property. The Commission stated that as this condition would undoubtedly result in the filing of a formal application for an increase in rates at some future date the present order is to be considered only as an expedient until the case may be gone into more thoroughly.

Among the tabulations of electric station statistics which have appeared in the decisions of the Commission from time to time the following is interesting as showing the statistics of a class of plants which is very prominent, as regards their number and population served, the aggregate population served by utilities operating in cities of under 5,000 population being equal to nearly forty per cent of the total population of cities having electric stations.

ELECTRIC UTILITIES IN CITIES OF 2,000-4,000 INHABITANTS.

City.	Population.	No. of Consumers.	K.W. Capacity.	Connected Load K.W.	Maximum Demand K.W.	Operating Expenses Exclusive of Taxes and Depreciation.
Bayfield	2,675	211	200	220	100	$ 4,863.78
Burlington	2,625	410	200	567	100	8,389.83
Delavan	2,321	...	90	275	85	7,533.71
Dodgeville	2,152	116	185	60	...	4,336.73
Edgerton	2,416	295	180	219	...	7,812.87
Elroy	2,011	310	150	90	65	4,900.00
Ft. Atkinson	3,300	555	200	100	100	9,642.36
Hartford	2,052	305	60	60	50	5,324.07
Hayward	2,000	288	220	142	180	3,530.87
Hudson	3,220	404	300	378	220	11,072.08
Hurley	2,000	232	800	...	600	4,374.00
Lake Geneva	3,449	366	380	720	154	17,674.41
Lancaster	2,555	194	180	332	130	8,463.14
Mineral Point	3,252	213	400	...	110	15,812.20
Neillsville	2,117	127	150	...	...	4,525.70
New London	3,002	288	190	100	...	8,394.50
Oconomowoc	3,013	351	240	547	26	11,560.05
Peshtigo	2,539	205	512	280	210	5,453.79
Prairie du Chien	3,179	228	180	250	135	5,584.23
Reedsburg	2,515	394	140	...	...	5,777.70
Rice Lake	3,410	409	320	...	79	2,816.96
Richland Center	2,635	289	150	130	84	8,932.59
Ripon	3,811	165	177	240	115	5,904.48
River Falls	2,300	357	275	349	154	3,512.09
Shawano	2,446	210	275	100	...	10,651.12
Sparta	3,807	334	335	337	321	9,991.37
Stanley	2,722	173	158	895	...	3,604.32
Tomah	3,008	264	210	...	...	4,905.23
Tomahawk	2,626	203	325	24	150	5,027.60
Waupun	3,111	320	162	449	118	7,320.06
West Bend	2,362	161	120	200	40	12,240.67
Average	2,730	279	241	283	145	7,417.18
Minimum	2,000	116	60	24	26	2,816.96
Maximum	3,811	555	800	895	600	17,674.41

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has approved of an agreement whereby the Geneva-Seneca Electric Company and the Wayne County Gas and Electric Company consolidate into and form the Central New York Gas and Electric Company. The consolidated company is authorized to issue its common and preferred stock in accordance with the terms and provisions of the consolidation agreement—one share of preferred stock and two shares of common stock in exchange for each three shares of the present outstanding stock of the constituent companies. The proceeds of the $950,000 bonds and stock to be issued are to be used for the purchase of the plant of the J. Q. Howe's Sons at Phelps at a price not exceeding $15,000, for the construction of the transmission line from Geneva and Newark via Phelps and for the construction of a substation at Phelps; for the retirement and cancellation of the existing outstanding bonds and mortgage debts, notes and unsecured indebtedness of the Geneva-Seneca Electric Company and the Wayne County Gas and Electric Company, and for the completion of the improvements to the plant of the consolidated company which have been authorized by the Commission. The new company is in control and will operate a number of lighting companies in Wayne and Ontario counties.

Members of the Public Service Commission have been informed of the withdrawal of the offer made by Frank J. Sprague and Oscar T. Crosby for the building and operation of a subway system in New York City. In withdrawing their proposition Mr. Sprague and Mr. Crosby intimate that they will still be prepared to bid for the equipment and operation of any independent line or system which may be approved by the Commission.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

A 30,000-HORSEPOWER PLANT FOR IDAHO.—About $2,000,000 will be expended by the Panhandle Electric Railway & Power Company, headed by Victor M. Smith, of New York, in the construction of a 30,000-horsepower plant on Priest River, in northern Idaho. A transmission line will also be built from the proposed plant to Spokane, a distance of seventy miles. The company offers to furnish street lights and power for the city's up-river pumping station under the price paid to the previous operating company.

A PENNSYLVANIA POWER SYSTEM.—Application is to be made to the governor of Pennsylvania on April 3 by W. A. Lathrop, Rollin H. Wilbur and H. F. Baker, of Philadelphia, for charters for about sixty electric companies. This will be the first public move in the fulfillment of the great power scheme of the Lehigh Coal & Navigation Company, which aims to electrify eastern Pennsylvania, affecting a territory with a population of 2,500,000 people, including Philadelphia. The company's electrification scheme has been in formation three years. Immense power houses are to be built at Lansford, to be run with coal that has heretofore been allowed to go to waste, as well as by water power. The main high-tension transmission lines, 132 miles long, are to run into Philadelphia, with branches to all industries, towns and villages that will contract to utilize the power. The first special aim will be an attempt to electrify the cement industry. The company says it can furnish electric power to the cement plants of the Lehigh region cheaper than they can generate it themselves by means of their present steam plants. Efforts will also be made to introduce light and power current into the larger cities.

LIGHTING AND POWER.

(Special Correspondence.)

APPLEWOLD, PA.—A new system of arc lights was recently installed here.

BAIRD, TEX.—T. A. Ward, of Comanche, Tex., will construct an electric light plant here. P.

YUMA, ARIZ.—H. W. Blaisdell has applied for an electric lighting franchise in this city. A.

ALLIANCE, NEB.—This city has voted bonds for $73,000 to construct an electric light plant. P.

MISSION, TEX.—The Mission Cotton Oil Company will install an electric light plant at this place. D.

ARKANSAS CITY, ARK.—This city is planning the establishment of a municipal electric light system. P.

MILWAUKEE, WIS.—The Badger Electric Company has been incorporated with a capital stock of $3,000. P.

NINNEKAH, OKLA.—The Ninnekah Electric Company has been incorporated with a capital stock of $1,800. P.

MISHICOTT, WIS.—It is proposed to install an electric light plant in the near future. Ira Beyer is interested. C.

CORNELL, WIS.—The Cornell Land & Power Company will shortly commence the erection of a power dam. C.

DEVILS LAKE, N. D.—Eastern capitalists are considering the installation of an electric light plan at a cost of $50,000. C.

MINOT, N. D.—The new owners of the electric light plant have secured a site for the erection of a two-story building. C.

HANKINSON, N. D.—The Phillips-Carleton Electric Company has been incorporated to install an electric light station. C.

LYNNVILLE, TEX.—The Lynnville Mill & Elevator Company contemplates putting in an electric lighting system here. P.

SUN PRAIRIE, WIS.—It has been voted to issue bonds for $9,000 for the installation of an electric lighting system. C.

NORTH BREWSTER, O.—Residents of this place are planning the erection of a co-operative electric light and water plant.

McCOMB CITY, LA.—Plans and specifications have been submitted for a sewerage system and a municipal electric light plant.

FERGUS FALLS, MINN.—The legislature will be petitioned to authorize the city to issue bonds which will pay for the construction of a dam. C.

EDMONDSON, ARK.—The Edmondson Electric Plant & Manufacturing Company has been incorporated with a capital stock of $50,000. P.

VANCOUVER, WASH.—The Mount Hood Light & Power Company has secured a fifty-year franchise for a light and power transmission system in this place.

SNYDER, NEB.—The old electric light plant here has been overhauled and is now in operation. A system of tungsten lamps for street lighting is to be installed.

LOS ANGELES, CAL.—Reports from Cananea, Mex., state that the Sunset Development Company, operating near there, is planning to put in an electric power plant. A.

ST. LOUIS, MO.—The electric plant in the basement of the City Hall is to be taken out and new machinery installed. The cost of the work will be about $70,000.

LOS ANGELES, CAL.—The city has by popular vote declared in favor of a municipal electric light plant. Power will be generated by the Owens River aqueduct.

RACINE, WIS.—The plant of the Racine Electric Light & Railway Company was burned with a loss of $125,000. Day emergency power will probably be secured from Milwaukee. C.

ALBERNI, B. C.—The Alberni District Electric Light & Power Company, Ltd., with head offices in Alberni, has been incorporated and will supply current for lighting within a short time.

PRAIRIE DU SAC, WIS.—James O. Heyworth, a contractor, of Chicago, has commenced work on the construction of a power dam across the Wisconsin River, which it is estimated will cost $1,500,000. C.

ST. CLOUD, MINN.—The Public Service Company will enlarge power plant No. 1 by the erection of a one-story brick building, 27 by 38, and the installation of a 600-horsepower generator and 750-horsepower water wheel. C.

COLUMBUS, O.—As a result of inquiries regarding the best method of street lighting, it developed that the downtown business men were almost unanimously in favor of retaining the present arches illuminated with incandescents.

DULUTH, MINN.—The Great Northern Power Company is considering the construction of a dam thirty feet high and 1,200 feet long, with concrete flumes and spillways, about twenty-six miles above Cloquet. The estimated cost is $1,000,000. C.

LEXINGTON, S. C.—An election will be held on March 28 to decide whether or not the city shall have electric lights. Recent calls for bids brought out only one offer, that of the Lexington Electric Light & Power Company, which offered to light the streets for $1,200 per year.

SAN BERNARDINO, CAL.—The Chuckawalla Valley Development Company is taking soundings in the Colorado River to secure a suitable site for a dam to be used in diverting water for its proposed power plant. The power developed is to be used for pumping for irrigation purposes. A.

GERBER, CAL.—The Gerber Water & Light Company has been incorporated here for the purpose of constructing and operating water and electric lighting plants. The capital stock of the company is $50,000, the directors being Edward H. Gerber, F. W. Kiessel and George W. Peltier. A.

MUNCIE, IND.—The American Gas & Electric Company will soon put in operation its lighting system in Eaton, twelve miles from here, the current being transmitted from the Muncie power house. The company is planning to furnish electricity to all the towns and villages in eastern Indiana. S.

SPOKANE, WASH.—The Panhandle Electric Railway & Power Company, in which Victor M. Smith, of New York, is interested, will construct a 30,000-horsepower plant on the Priest River in Northern Idaho, and a transmission line from here to Priest River, a distance of seventy miles, at a cost of $2,000,000. C.

MARION, IND.—The Upland Electric Company has filed articles of incorporation with the Secretary of State. The object of the organization is to supply cities, towns, villages, communities, places of amusement, with electric light, heat, power, gas, or water. The directors of this company are George N. Tidd, H. L. Finley and Frank B. Ball S.

ORLAND, CAL.—Articles of incorporation of the Peoples Power Company have been filed in Glenn County and the company has been formally organized by the election of the following officers: C. R. Wickes, president; D. A. Shellooe, vice president; W. H. Travis, secretary. The capital stock of the corporation is $180,000.

SAN FRANCISCO, CAL.—The Great Western Power Company, of this city, has placed on record at Quincy, the county seat of Plumas County, Cal., deeds to power rights to 875,000 miner's inches of water in Feather River and Butte Creek, there being one location for 500,000 inches, one for 75,000 inches and two for 150,000 inches each. A.

LOGANSPORT, IND.—The Wabash Power Company, headed by Quincy A. Myers, Walter Omer and others, have adopted plans for the construction of a power dam at Georgetown four miles south in the Wabash River. The object is to generate electricity and transmit it to the towns, cities and communities within a radius of twenty-five miles. S.

LAPORTE, IND.—Articles of consolidation of the Northern Indiana Gas & Electric Company, with a capital stock of $5,000,000, has been filed. The new corporation is a merger of the South Shore & Electric Company, the Indiana Harbor & East Chicago Electric Company, the Plymouth Lighting Company and the Whiting Electric Light Company. Clarence H. Geist of Philadelphia is president, Samuel T. Bodine vice-president, and Lewis Lillie, secretary.

OGDEN, UTAH.—The Merchants' Light & Power Company which was granted a franchise by the City Council here, has now been incorporated with a capital stock of $500,000. The officers of the concern are: M. S. Browning, president; A. L. Brewer and J. S. Lewis, vice presidents; Arthur Kuhn, secretary, and Charles E. Kaiser, treasurer. Danville Decker, for several months local manager for the Utah Light & Railway Company, has been selected as local manager for the new concern.

YREKA, CAL.—The Siskiyou Light & Power Company has begun construction work on its dam at the head of Ward's Canyon on the Klamath River. The dam will be 250 feet long and ninety feet high, and is intended to impound water to develop 20,000 horsepower. Work will soon be commenced on transmission lines to Klamath Falls and Butte Creek Valley. The company has applied for a franchise to run transmission lines on the public highways of Shasta County outside of incorporated towns. A.

GUANAJUATO, MEX.—The Guanajuato Power and Electric Company of Guanajuato is very active at this time in the installation of irrigating pumps upon farms in the central part of the state of Guanajuato. In the vicinity of Silao transformers and motors to operate the irrigation pumping plants are being installed upon a number of farms by the company under the direction of Pablo Rocha, local manager. The country all through the agricultural portions of the state is dotted with newly built transformer houses, and electricity for both light and power is being furnished the people of the rural districts. D.

GREENVILLE, S. C.—The new auxiliary steam electric plant of the Southern Power Company costing $100,000 or more, and one of the largest in the south, has again been started up. The plant has a boiler room 200 by 52 feet, and the generator room is 95 by 50 feet. The equipment includes Erie City vertical boilers, one turbine, one generator, two air pumps, two exciters, water pumps, etc. The building is of concrete and is the first of three such auxiliary plants that the company expects to erect as necessary in case of the hydroelectric system is put out of commission for a short time for any reason. L.

MEXICO CITY, MEX.—An electric transmission line is being constructed from the power plant of the Copper Queen smelter at Douglas, Ariz., to El Tigre, sixty-five miles. This transmission line will carry 45,000 volts, and in addition to supplying power for operating the machinery of the mines and ore reduction mills of El Tigre district, it will go to supply power for industrial plants at Fronteras Ysabel and other places. The Mexican Government has decided that the electric current should be admitted free of duty. The power plant of the Copper Queen Company is being enlarged to provide the additional power for the new service.

GARRETT, IND.—An interesting suit has been brought in the DeKalb court against the Toledo & Chicago Interurban Railroad to enforce a contract. The city contends that when the interurban railway got a franchise permitting it to use the streets of Garrett it agreed to supply electric lighting for the streets over which the tracks were laid. The agreement has not been carried out, it is alleged. The city is attempting to force the company to light the streets used and also recover for the amount the city has paid out for street lighting during the time the road has failed to carry out the specific contract. The suit is important and interests other companies that are likewise said to be delinquent on agreements of the same kind. S.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SHEBOYGAN, WIS.—The Milwaukee & Northern is planning the extension of its line to Manitowoc. C.

SEATTLE, WASH.—Bonds for $800,000 for the construction of a municipal street railway have been voted. C.

SOUTH OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company will build a transforming station at a cost of $12,000. C.

LAKE CITY, MINN.—A franchise has been granted to the Missouri Valley Southern Electric Railway Company to construct a line on Main Street. C.

LOS ANGELES, CAL.—Dr. W. F. McBurney has asked for a franchise for a cross-town car line on Vermont Avenue, from Fourth to Vernon Avenue in this city. A.

LUNDGREN, IOWA.—The Fort Dodge, Des Moines & Southern railway will commence the immediate construction of a new line to Lehigh, about eight miles long. C.

WILLMAR, MINN.—The Arctander Railway Promoting Organization has been organized, Ben Halverson, secretary, Norway Lake, for the constructing of an electric line. C.

WAYNESBORO, PA.—Active work on the new trolley extension from Pen-Mar to Highfield is now being carried on. Ties and rails have been laid from Highfield to Cascade, Md.

HUNTSVILLE, ALA.—A project is on hand among prominent business men of the Decaturs to build an interurban railroad between Huntsville and Decatur. A preliminary survey will be made.

SALINAS, CAL.—F. G. Daum, chief engineer of the Monterey County Gas & Electric Company, has made application for an electric railway franchise from Monterey along the Salinas Road to Castroville, via Salinas. A.

HOUSTON, TEX.—The Bay Shore Traction Company of Houston will begin the construction of its proposed interurban electric line that is to run from South Houston to La Porte within the next few months, it is announced. D.

LONG BEACH, CAL.—H. C. Pike has secured a franchise for a scenic electric railroad on Pike Street in this city and announces that construction work will be under way by the first of April. The road is estimated to cost $85,000. A.

CHARLOTTE, N. C.—On March 14 the Southern Power Company, recent purchasers of the Charlotte Electric Street Railway Company, inaugurated the Pay-as-you-enter system on all cars operated over their twenty miles of lines. L.

FRESNO, CAL.—The directors of the Fresno, Hanford & Summit Lake Railway Company have signed a deed of trust to the Guaranty Trust Company, of New York, to secure the company's proposed issue of bonds for the construction of the road. A.

DALLAS, TEX.—The Dallas Street Railway Company, of Dallas, has been organized with a capital stock of $20,000 for the purpose of maintaining and operating suburban railways. George W. Works, W. Leslie Williams and A. C. Moser are the incorporators. D.

AUSTIN, TEX.—The State Legislature has enacted a law granting the county of Galveston the right to sell or lease a right of way for an electric or steam railway over or upon the seawall that has been constructed along the Gulf. This seawall is about five miles long. D.

SAN FRANCISCO, CAL.—The Board of Public Works has authorized the expenditure of not to exceed $60,000 for the purchase of special track work material for the proposed Geary Street municipal electric railway. The Board has also called for bids for tubular steel poles and for redwood cross ties. A.

BUFFALO, N. Y.—Official announcement has been made by the Beebe Electric Railway System in Syracuse that plans for extensive improvements on the recently acquired Buffalo, Lockport & Rochester Railway have been approved and that the engineering department is ready to begin work immediately.

DES MOINES, IOWA.—The property of the Des Moines City Railway Company has been sold to N. W. Harris & Company which already owned fifty-two per cent of the stock. The property is valued at $4,500,000. The actual cash transfer was $600,000. The properties will be improved at once, it is announced. Z.

ROCHESTER, N. Y.—The contract has been signed for the extension of the Stroudsburg & Water Gap Railway from Castle Inn, at Delaware Water Gap, to Portland, Northampton County. This stretch, five miles long, will be the last link of a through trolley route from Philadelphia to Delaware Water Gap.

MODESTO, CAL.—The San Joaquin Valley Electric Railway Company has been granted a franchise for an electric road through this city. This is the first of the two electric roads to enter this city within a few months. The Tidewater and Southern Railway Company will begin work on a line in this city about the middle of this year. A.

INDIANAPOLIS, IND.—Indianapolis & Delphi Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The object of the company is to acquire, own, maintain and operate a street and interurban railroad in and between and connecting the cities of Indianapolis and Delphi and the intervening towns. S.

SAN FRANCISCO, CAL.—A bill has just been signed by the Governor of California, giving to the city of San Francisco the right to construct and operate a belt line municipal street railway along the water front from the eastern boundary of the Presidio to the San Mateo County line. The right is never to be assigned nor transferred by the city.

CHARLOTTE, N. C.—The property of the Burgrahaw Traction Company has been sold for the sum of $26,030. The property consists of the franchises, rights-of-way of the incompleted electric system extending from Burlington to Graham and Haw River, over which grading has practically been completed and rails laid about two-thirds of the distance.

ATLANTA, GA.—At the annual meeting of the board of directors of the Georgia Railway & Electric Company in this city President P. S. Arkwright was re-elected for another term together with practically all of his staff of officers. Changes made include the election of W. H. Glenn, manager of railways, to the office of vice-president of the company. L.

IOWA CITY, IOWA.—The $3,000,000 worth of bonds issued by the Iowa City-Ottumwa Interurban Railway Company, to raise money with which to build the projected line, have been sold in London, according to a recent announcement. The bonds are said to have brought a higher rate than any interurban railway bonds from America ever before sold in England.

ROCKFORD, ILL.—The Rockford City Traction Company was incorporated with a capital stock of $10,000, which later was increased to $2,000,000, to operate street railway lines. The incorporators are A. A. Anderson, Warren Partridge and P. B. Warren, all of Springfield, Ill. The object of the corporation is stated to be the separation of the Rockford lines from interurban properties. Z.

CITY OF MEXICO, MEX.—The Mexico Traction Company is having surveys made for its proposed interurban electric line that is to be constructed between this city and Puebla, 160 miles. The construction work will be started in a chort time. It is reported that the company also contemplates constructing an interurban electric line from the City of Mexico to Cuernavaca, about seventy-five miles. D.

SAN BENITO, TEX.—The interurban railway system that is being constructed out of San Benito to various points in the lower valley of the Rio Grande will be extended to Santa Maria and Mission, about seventy-five miles. S. A. Robertson of San Benito is largely interested in the road and is doing the construction work. It is reported that a syndicate of St. Louis, Mo., men is financing the project. D.

VINCENNES, IND.—The Vincennes-Interstate Traction Company has filed articles of incorporation with the Secretary of State. The company proposes to build and operate an interurban railroad from Vincennes to Bridgeport and the oil fields in Illinois. The capital stock, which is $10,000, is to be increased. John L. Kleymeyer, Chas. Benham, H. M. Lukens, C. H. Batton and A. W. Funkhouser are directors. S.

RUTHERFORDTON, N. C.—The Isothermal Traction Company, organized to build an electric line from Gastonia to Asheville, N. C., via this town, has had its charter amended by the legislature, changing the name to the North Carolina Interurban Railway Company. The new charter gives the right to the owners also to make physical connection of their lines with the Seaboard, Southern and Carolina, Clinchfield and Ohio Railroads. L.

DENVER, COLO.—The Uncompahgre & Gunnison Valley Railroad Company, which has for its object the building of an electric freight and passenger line in the Uncompahgre valley, with Montrose, Delta, Olathe and Cedaredge as the principal points, will build its first twenty miles of track south from Cedaredge before next fall, according to L. N. Pepper of Montrose, vice-president of the company. Between $500,000 and $1,000,000 will be expended for completion of the new line.

OAKLAND, CAL.—The Southern Pacific Railroad Company has asked for a thirty-five-year franchise along Seventh Street, in this city, for its proposed electric suburban line connecting with the company's ferry boats to San Francisco. The company offers to make an annual payment of $5,000 to the city during the first fifteen years, a payment of $8,500 during the remainder of the thirty-five years, to pave the street at a cost of $200,000 and to light the street at a cost of $9,000 per year. A.

HENDERSON, KY.—Articles of incorporation for the Henderson Interurban Railway Company, with a capital of $10,000, have been filed. The charter provides for the construction and operation of electric railways in Kentucky. It is proposed if engineering reports develop the feasibility of so doing to build standard-gauge electric railways for the conveyance of both passengers and freight between Henderson and Dixon, Henderson and Uniontown via Morganfield, and Henderson and Owensboro. The aggregate length of these lines will be about eighty-five miles. The incorporators of the company are E. F. Wheaton and F. M. Smith, of Nashville, and W. W. Cooper, of Smith Mills.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

GREY EAGLE, MINN.—It is proposed to extend the telephone line at Oak Haven. C.

LANESBORO, MINN.—M. W. Williams and others are organizing a telephone company. P.

PLYMOUTH, WIS.—The Spring Telephone Exchange has been organized to build a rural line. P.

FORT MADISON, IOWA.—The Mississippi Valley Telephone Company will improve its plant. C.

MITCHELL, S. D.—The Dakota Central Electric Company is considering the installation of an automatic system. C.

STRANG, NEB.—The Bell Company is considering the construction of a telephone line southwest from here. C.

VALE, ORE.—The City Council has granted a telephone franchise to H. S. Johnson, who will install his system in a short time.

MOBRIDGE, S. D.—A franchise has been granted to the Missouri Valley Telephone Company to construct a telephone system in this place. C.

LEWISTON, MONT.—The Great Divide Telephone Company has been organized to construct a rural line south and east of here. P.

LOYALSOCK, PA.—The Loyalsock Telephone Company has decided to make extensive improvements in its system. New lines are being built.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has decided to expend $850,000 in improvements throughout the state during the year. C.

BYRON, IND.—The Byron Telephone Company has been incorporated with a capital of $1,000 by H. I. Démarree, H. C. Morgan and T. M. Garland.

MARMADUKE, ARK.—The Marmaduke Telephone Company has been incorporated with capital stock of $10,000 to conduct a general telephone business. Z.

WEST POINT, NEB.—John Meier will erect a brick or cement stone building, the upper story of which will be fitted up for the Nebraska Telephone Company. C.

ALPINE, TEX.—The Alpine Telephone Company has been incorporated with capital stock of $15,000 by H. D. McDonald, W. F. McGaughey and R. T. Rusks. (Z.

MILWAUKEE, WIS—The Wisconsin Telephone Company will erect exchange buildings on the northwest side and also in Appletion, Beloit and Fond du Lac this year.

APPLETON, WIS.—The Wisconsin Telephone Company has secured a site at Superior and Washington Streets for the erection of an exchange estimated to cost $100,000. C.

BARRY, TEX.—The Vest Telephone Company has been incorporated with capital stock of $20,000. The incorporators are D. W. Vest, J. W. Denton and A. H. Elmore. Z.

JACKSONVILLE, ILL.—The Central Union Telephone Company will expend $10,000 in rebuilding its lines from Arcadia to Prentice and from Jacksonville to Literberry. Z.

NASHVILLE, TENN.—The Bush Creek Telephone Company has been incorporated with a capital of $1,000 by Robert Gwathney, T. H. Nixon, C. A. Bridges, E. W. Jenkins and B. G. Lawrence.

TOPEKA, ILL.—The Farmers' Mutual Telephone Company has been incorporated with capital stock of $2,500 to operate rural telephone lines. The incorporators are C. H. Bartel, A. D. Messman and M. N. Smith. Z.

ROCK FALLS, WIS.—At a meeting of a hundred or more Rock Falls farmers preliminary steps toward the organization of a telephone company were taken. An exchange at Rock Falls, to be connected with the Eau Claire exchange, was planned.

ATLANTA, GA.—The report of the earnings of the Southern Bell Telephone Company in this city for the past year shows a total of $558,628 against $479,576 for the year preceding. The company's taxes on gross earnings for the year amount to over $1,600. L.

SEMINARY, TENN.—An independent telephone company has been organized and the erection of the company's poles and the installation of its office outfit begun. This company will connect with the independent system of this place. Atwood, McKenzie, Bradford, Gleason, Trenton, Hickman, Ky., and other places in this section of the state.

GREENVILLE, N. C.—The new telephone building being erected for the Southern Bell Telephone Company's local exchange here, will be a model in every particular. The structure will be three stories with basement, and will be fitted with steam heat, etc., the total cost being over $20,000. The architects are King and Walker, of New York City, and the supervising architects are F. H. and J. G. Cunningham, of Greenville. Special attention will be given to the comfort and convenience of the operators of the exchange, and the building will contain many new and modern ideas in telephone-exchange building construction. L.

ELECTRICAL SECURITIES.

Although there have been a number of marked advances in values the volume of trading was rather small. The total, however, amounted to about fifty per cent more than during the previous week. There is considerable doubt as to whether the Supreme Court decision in the Standard Oil and American Tobacco cases will be handed down at once or in the course of the next few months, yet this uncertainty only seems to have the effect of keeping the traders on the alert. But little apprehension has as yet been shown over the Mexican trouble, and the market is, in general, quiet.

The Narragansett Electric Lighting Company stockholders have authorized $1,500,000 four per cent convertible debentures to pay floating debt and make additions.

The annual meeting ofthe American Telegraph & Telephone Company will be held March 28, at noon.

An issue of $2,000,000 of refunding five per cent bonds of the California Gas & Electric Company, due 1937, has been sold at ninety-four and interest.

All of the $15,000,000 of Mississippi River Power Company first mortgage five per cent four-year gold bonds, offered by Kidder, Peabody & Company, and Stone & Webster, have been sold. London and Canadian investors took a large part of the issue.

The Central Trust Company of New York for itself and in behalf of Kuhn, Loeb & Company, the Farmers' Loan & Trust Company and the Guaranty Trust Company has purchased $6,250,000 five per cent receivers' certificates of the Metropolitan Street Railway Company to be issued to take up a like amount of receivers' certificates maturing March 15, 1911.

DIVIDENDS.

American Cities Railway & Light Company; quarterly dividend of one and one-half per cent.

American Telephone & Telegraph Company; regular quarterly dividend of two per cent, payable April 15 to stock of record March 31.

Bell Telephone of Canada; quarterly dividends of two per cent, payable April 15.

Butte Electric & Power Company; regular quarterly dividend of one and three-quarters per cent on the common stock, payable April 1 to stock of record March 20.

Union Traction Company of Indiana; preferred semiannual dividend of two and one-half per cent, payable April 1.

Western Electric Company; regular quarterly dividend of two per cent, payable March 31 to stock of record March 24.

Tri-City Railway & Light Company; preferred quarterly dividend of one and one-half per cent, payable April 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Mar. 20.	Mar. 13.
Allis-Chalmers common	7⅞	7⅞
Allis-Chalmers preferred	31	30
Amalgamated Copper	63⅞	62½
American Tel. and Cable	*80¾	80¾
American Tel. & Tel.	146	144¾
Brooklyn Rapid Transit	77½	76½
General Electric	148	147
Interborough-Metropolitan common	19⅝	18⅝
Interborough-Metropolitan preferred	54¾	51
Kings County Electric	129	126
Mackay Companies (Postal Telegraph and Cables) common	90½	92¼
Mackay Companies (Postal Telegraph and Cables) preferred	75	74½
Manhattan Elevated	136	138⅞
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel	52½	53
U. S. Steel common	78	76⅛
U. S. Steel preferred	118½	118
Western Union	72	71¾
Westinghouse common	66	66¾
Westinghouse preferred	120½	117

*Last price quoted.

BOSTON.

	Mar. 20.	Mar. 13.
American Tel. & Tel	146	144⅞
Edison Elec. Illuminating	289	288
General Electric	148½	149
Massachusetts Electric common	17¾	16½
Massachusetts Electric preferred	87	87
New England Telephone	142	144
Western Tel. & Tel. common	20	20
Western Tel. & Tel. preferred	93	92

PHILADELPHIA.

	Mar. 20.	Mar. 13.
American Railways	44	42½
Electric Company of America	12	12
Electric Storage Battery common	54	53½
Electric Storage Battery preferred	54	53½
Philadelphia Electric	16⅛	16⅛
Philadelphia Rapid Transit	19⅛	19¾
Philadelphia Traction	84	86¼
Union Traction	47¼	47

CHICAGO.

	Mar. 20.	Mar. 13.
Chicago Railways, Series 1	90	90
Chicago Railways, Series 2	24	24
Chicago Subway	4⅞	4⅞
Chicago Telephone	120½	119½
Commonwealth Edison	126¾	123
Metropolitan Elevated common	21	21½
Metropolitan Elevated preferred	69	66

PERSONAL MENTION.

GEORGE ALFRED GOODENOUGH, who was for many years associate professor of mechanical engineering of the University of Illinois, has been made professor of thermodynamics.

E. F. SHERWOOD, superintendent of the New York Telephone Company, addressed the Telephone Society of New York on March 22 on the subject, "Efficiency in Traffic Work."

H. G. CONGER, who has been manager of the Iowa Telephone Company's properties at Iowa Falls, Iowa, has been made commercial manager for the same company at Des Moines, Iowa.

J. D. ROSS, for several years electrical engineer in the municipal lighting department of Galveston, Tex., has now been appointed superintendent of that department. Mr. Ross succeeds Richard W. Arms, who recently resigned.

CALVIN WHITELEY, JR., has resigned his position as chief engineer of the Virginia Railway & Power Company, of Richmond, Va., and has accepted the post of chief engineer of the United Railways of Baltimore, Md. On leaving Richmond, Mr. Whiteley was presented with a handsome Masonic ring by the officials of the company.

W. L. BROWNELL, treasurer of the Crocker-Wheeler Company, Ampere, N. J., delivered an address before the Newark branch of the National Association of Credit Men, on the subject "Should Terms of Payment be Enforced?" This address, which has attracted the attention of credit men throughout the country, has now been reprinted in pamphlet form.

S. E. DOANE, chief engineer of the National Electric Lamp Association, addressed the Engineers' Club of Cleveland, on Tuesday evening, March 14, at the Chamber of Commerce. Mr. Doane spoke on "The Value of Co-Operation in Engineering." His talk was illustrated by lantern slides, showing how the standardization of materials in the incandescent lamp industry has been made possible through co-operation.

CHARLES RUSS RICHARDS, dean of the college of engineering of the University of Nebraska, has been appointed professor of mechanical engineering in charge of the department at the University of Illinois. The appointment takes effect September 1, 1911. Mr. Richards has been actively engaged in engineering instruction work since his graduation from Cornell in 1895 and did notable work in building up the engineering department of the University of Nebraska. He is a member of the American Society of Mechanical Engineers, the Society for the Promotion of Engineering Education, the Nebraska Academy of Science, and of the Sigma Xi, Tau Beta Pi, and Sigma Chi fraternities.

OBITUARY.

JOHN B. McDONALD, well known as the builder of the New York subway, died in New York on March 16 after an illness of some months. Mr. McDonald first studied construction methods when employed as a timekeeper on the Croton dam and was later employed on the Hoosac tunnel, afterward taking the contract for the Vanderbilt tunnel on his own account. The funeral took place on March 20, and in Mr. McDonald's honor all current was cut off from the subway lines for a period of two minutes.

NEW INCORPORATIONS.

CINCINNATI, O.—The Mica Electric Sign Company has been incorporated with a capital of $10,000 by Hugh Mulholland, John H. Wilson, Elijah B. Rogers, Robert Scannell and Tilly E. Wilson.

INDIANAPOLIS, IND.—The C. J. Olsen Manufacturing Company of Pittsboro has been incorporated to manufacture combined insulators and lightning arresters, etc. The directors are W. F. Hiatt, C. J. Olsen and C. A. Weaver.

HANKINSON, N. D.—The Phillips Carleton Electric Company, which will deal in supplies, etc., has been incorporated with a capital of $20,000. The incorporators are Geo. F. Phillips, J. T. Eager, M. E. Phillips and E. L. Carleton.

INDIANAPOLIS, IND.—The Roth-Murphy Engine Starter Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The object of the company is to manufacture and sell a patented device known as the Roth-Murphy starter. David R. Murray, Indianapolis, and Gilson W. Roth, Morgantown, Ind., are directors. S.

PROPOSALS.

POST OFFICE, AMES, IOWA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 17 for the construction, complete (including plumbing, gas piping, heating apparatus, and electric conduits and wiring), of the United States post office at Ames, Iowa, in accordance with the drawings and specifications, copies of which may be obtained from the custodian of site at Ames, or at the Supervising Architect's office.

POST OFFICE, TERRELL, TEX.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 25, for the construction, complete (including plumbing, gas-piping, heating apparatus, electric conduits and wiring), of the United States post office at Terrell, Tex., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Terrell, or at the Supervising Architect's office.

NEW PUBLICATIONS.

ILLINOIS STATE ELECTRICAL ASSOCIATION.—The proceedings of the eleventh annual convention of the Illinois State Electrical Association, which was held at Rock Island, Ill., October 25, 26 and 27, have been published and distributed to the membership. This volume forms a very interesting and valuable addition to the literature of central station subjects and the organization is to be congratulated upon the character and appearance of its publication.

BULLETIN OF CANADIAN DEPARTMENT OF MINES.—The Department recently published three pamphlets under the following titles: "Magnetic Concentration Experiments," "Preliminary Report on the Mineral Production of Canada," and "An Investigation on the Peat Bogs and Peat Industry of Canada." The latter goes into the subject of peat fuel in considerable detail and contains a number of illustrations showing the methods of securing and drying the peat. Numerous maps and diagrams accompany the publication.

WATER POWERS OF THE GREAT BASIN.—The Geological Survey's census of the water resources of the United States is contained in a series of its reports called "water-supply papers," the latest issue of which, No. 270, is devoted to the waters of the Great Basin, comprising western Utah, nearly all of Nevada, and parts of Idaho, Oregon and California. The report describes the general features of the basin and gives the discharge of the most important streams of the region as shown by measurements made at numerous stations during the year 1909. The flow of some of the streams has been used to generate electric power, and there are many unutilized sites for good power plants. The report notes that more than 100,000 horsepower is available without storage in Owens River basin alone. Three power plants installed on Truckee River generate about 2,500 horsepower each. The report was prepared by E. C. La Rue and F. F. Henshaw, and can be obtained free by applying to the Director of the United States Geological Survey, Washington, D. C.

LEGAL NOTES.

DUTY AND LIABILITY WHERE WIRES AND POLES ARE BLOWN DOWN BY STORM.—Where telephone or telegraph wires are thrown down across a public highway by a storm, the owner of such wires must use all haste possible to remove them, and, failing to do so, will be liable for any damage caused by its failure to use the required diligence. And where telegraph or telephone poles of insufficient strength or which have become decayed are blown down in a storm, and are the cause of injury, it will not avail the company to show that good poles were blown down by the same storm, for different conditions of soil and protection might have caused the fall of the latter. In the absence of other proof, the weakness or decay of the poles will be held to be the proximate cause of the damage.—Supreme Court of Louisiana in Claussen vs. Cumberland Telephone & Telegraph Company, 53 So. 357.

RULE COMPANY FURNISHING LIGHT AND HEAT CANNOT ENFORCE.—The Supreme Court of Colorado holds that a company organized for the purpose of manufacturing and selling electric light and steam or water heat, having a franchise from a city to carry on that business within its limits, and which has installed pipes and other appliances in and under the streets to conduct the steam or water intended for heating purposes, cannot require a consumer to take electric current for lighting purposes as a condition precedent to being furnished with steam for heat, any more than it could say "We will not furnish you with electric current unless you also take steam." The consumer has the right to determine for himself which commodity he will take. Nor is this changed by the fact that the exhaust steam used for supplying heat is a by-product produced by the generation of electric current for light and power, and that if the steam-heating proposition were to be run independently it could not be operated at a profit.—Seaton Mountain Electric Light, Heat & Power Company vs. Idaho Springs Investment Company, 111 Pac. 834.

ELECTRIC PARALLELING STEAM RAILWAY NOT A NUISANCE.—The Appellate Court of Indiana, Division No. 1, holds that a demurrer was properly sustained to the complaint of a steam railway company which asked that an electric railway company be enjoined from operating its line of railway until it should adopt such electrical devices or other appliances as would neutralize the inductive current of electricity alleged to interfere with the maintenance and use by the complainant of its system of electric telegraph lines and signals necessary in the operation of its railway. The court says that the business carried on by the defendant was not a nuisance per se. The use of electricity was common to both parties, and both were acting under legislative grants. In such cases it seems to be the consensus of opinion, both in England and in this country, that where one is acting under legislative authority, and within the right thus given, and reasonably within the exercise thereof, using care and caution regarding the rights of his neighbor, any inconvenience or incidental damage which may arise in the absence of any negligence from the reasonable use of his own property will be regarded as of the kind for which no action will lie.—Lake Shore & Michigan Southern Railway Company vs. Chicago, Lake Shore & South Bend Railway Company, 92 Northeastern Reporter, 989.

INDUSTRIAL ITEMS.

(Special Correspondence.)

THE CROCKER-WHEELER COMPANY, Ampere, N. J., describes its polyphase induction motors in a bulletin which was recently issued.

THE BUCKEYE ELECTRIC LAMP COMPANY, S. A., announces that its Mexico City office has been moved from Avenue 16 de Septiembre, No. 5, to Avenue Jaurez No. 14. Mail matter should be addressed to Apartado Postal No. 746.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, O., has issued the March number of its interesting periodical, *Common Sense*. The issue contains the usual number of humorous, sociological and business items.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., has mailed the March issue of *The Federalist* to those interested. Some interior lighting installations are mentioned and several Federal units for 500-watt lamps are illustrated.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., recently issued the March number of *Trumbull Cheer*. Among other things a number of steel cabinets, panel boards and wood cabinets are illustrated and described.

MAC GOVERN, ARCHER & COMPANY, New York, N. Y., are advertising their complete line of electrical and steam machinery, cars and equipment in their March price list. Some of the machinery listed is second hand, but a considerable proportion of it has never been used.

THE RICHARDSON-PHENIX COMPANY, Milwaukee, Wis., a manufacturer of oiling devices has opened a branch office in the Keystone Building, 324 Fourth Avenue, Pittsburg, Pa. The office will be under the management of H. L. Laughlin, who has been with the company for a number of years.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., states that the completion of the new building for which ground was broken last week will add 8,000 square feet of floor space to its plant at Cleveland. The building will front on Marquette Road and is built to take care of the company's rapidly increasing business.

CROCKER-WHEELER COMPANY, Ampere, N. J., announces the appointment of Clarence E. Delafield as district manager of the Boston, Mass., territory. His headquarters will be at the office of the company in the Boston Safe Deposit & Trust Building, 201 Devonshire Street, Boston, Mass. Mr. Delafield takes the place of R. N. C. Barnes, who resigned.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received an order from Workman, Clark & Company for electrical equipment for three steamers which are being built for the United Fruit Steamship Company. The equipment includes turbine generating sets, motors for refrigeration, ventilation, etc., controlling switchboards and panels, and searchlights.

THE COOPER-HEWITT ELECTRIC COMPANY, Hoboken, N. J., describes its indoor type P lamp in Bulletin 36, which includes also data and specifications of this type of lamp. A booklet which the company publishes under the title "Better Than Daylight," contains a number of arguments along the lines of the light color and the superiority of the Cooper-Hewitt lamp from this particular standpoint.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., recently published the March number of *Juice*, in which is contained a number of articles regarding its new and its established standard products. Among these is an item on long-leaf Southern pine crossarms and another on insulator specifications. The subjects of illumination and illuminating fixtures are treated, and No. VIII of the series of wiring tables is included.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has received from the Rio de Janeiro Tramway Light & Power Company, an order for a duplication of the equipment purchased about a year ago. This consisted of a 2,000-kilowatt motor-generating set. Walter Brothers & Company, also of Rio de Janeiro, have placed an order for one 110-kilovolt-ampere and one 100-kilovolt-ampere, three-phase, sixty-cycle, 11,000/2,200-volt transformers. In addition this company has ordered a 110-kilovolt-ampere, water-wheel, type G generator.

THE SANGAMO ELECTRIC COMPANY, of Springfield, Ill., has applied its ampere-hour meters to the control of large electroplating operations, eliminating the old method involving the use of ammeters and clocks to secure the proper amount of deposit. Among those who have adopted the Sangamo meters are the Oneida Community, Ltd., Niagara Falls; International Silver Company, Meriden and Bridgeport, Conn.; Cincinnati Coffin Company, Alvin Silver Company, Joseph Fahys Watch Case Company, Gorham Manufacturing Company, Yale & Towne Manufacturing Company, J. B. Williams Company, etc. An interesting bulletin on this subject has been issued, and will be mailed upon request.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., states that an advance report made on a fire which occurred in the cellar of a residence using "J.-M." asbestos coverings, was found to be in error. The first report was that the furnace-pipe covering fed the fire, but the owner of the house stated in a letter: "Had it not been for the asbestos coverings, we should have had a much much larger fire. The asbestos on one pipe, as on one or two others, was in such good condition that it was not removed or renewed in September when the furnace was examined and cleaned for the winter. When the firemen cut away the pipe covering, they found underneath the asbestos old rags that had doubtless been put there before I bought the house several years ago. The asbestos completely covered the rags. The rags caught fire and the asbestos covering prevented them from blazing up, so that the firemen found no blaze—just a smouldering fire, and they had only a few moments' work."

DATES AHEAD.

American Supply and Machinery Manufacturers' Association. Annual meeting, Louisville, Ky., April 3, 4 and 5.

American Electrochemical Society. Annual meeting, Chemists' Club Building, New York, N. Y., April 6, 7 and 8.

Missouri Electric, Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) March 14, 1911.

986,449. SECONDARY OR STORAGE BATTERY. Bruce Ford, Philadelphia, Pa. Filed May 4, 1908. The battery jar has a cover with a rim and flange, the latter holding a sealing compound so that it cannot flow into the jar if it should melt.

986,451. ADJUSTABLE LIGHT OR OTHER FIXTURE. William L. Franks, Rock Island, Ill. Filed March 16, 1910. The base of the stand has a top plate with a circular opening, below which is a similar plate. A ball larger than the openings carries the fixture stem and is supported in any position between the two plates, springs holding the lower plate against the ball.

986,457. TIME-RECORDER. Warren L. Green, New York, and William S. Eaton, Sag Harbor, N. Y., assignors to American Bank Note Co. Filed August 25, 1906. A stylus bearing on a clock-operated disk makes a special record under the control of an electromagnet.

986,463. SELF-ADJUSTING FUSE. James Oliver Holton, Jr., Monett, Mo. Assignor of one-fifth to J. L. Jeffries, Monett, Mo. Filed Janu. 20, 1910. An automatically replacing fuse device for use with a lightning arrester carries a set of fuses, each supporting a coiled spring adapted to connect it in circuit when the next preceding fuse is melted.

986,479. CARD-PUNCHING MACHINE. Pieter Matthijssen, Eindhoven, Netherlands. Filed July 12, 1909. Electromagnets are arranged to unlock the punches in accordance with the design of a metallic pattern plate.

986,448. ELECTRIC IRON. Robert Preston Moodie and Charles Warren Ball, Ottawa, Ontario, Canada. Filed Aug. 14, 1908. A flat iron has two tubular holes in its body into which fit the heating elements which comprise resistance wire wound on an insulating spool.

986,494. ROSETTE. Bernard Nealis, Fulton, N. Y. Filed April 19, 1910. Mounted on the rosette cap is a resilient lamp hanger with a conductor clamp at its lower end.

986,506. PROCESS OF COUPLING PIPES. Frederick Sargent, Chicago, Ill., assignor of one-half to Olaf E. Oleson, Chicago, Ill. Original application filed Dec. 18, 1909. Divided and this application filed Nov. 3, 1910. Consists in permanently mechanically clamping the abutting ends of the pipes together, and then electrically welding the ends of the pipes together to seal the joint.

986,550. ELECTRIC-LIGHT FIXTURE. James S. Cumming, St.

Louis, Mo. Filed Sept. 7, 1909. A resilient tubular member contains a shock absorber.

986,554. MAGNETIC SEPARATOR. Alvin Dings, Milwaukee, Wis., assignor to Dings-Electro Magnetic Separator Co., Milwaukee, Wis. Filed March 6, 1907. A conveyor belt passes underneath a revolving wheel having auxiliary polepieces at its periphery and co-operating with the stationary poles of two electromagnets whose coils straddle the belt.

986,558. METALLIC FILAMENT FOR INCANDESCENT ELECTRIC LAMPS. Karl Farkas, New York, N. Y., assignor of one-half to Guy V. Williams, New York, N. Y. Filed Aug. 6, 1909. The process of producing compound filaments consists in heating electrically a fine silver wire in a rarefied atmosphere composed of about 85 per cent of vapors of a tungsten compound, about 8 per cent of vapors of chloride of silver, and 7 per cent of pyrogallol vapors, producing thus a refractory coating on the fine conductor, and reducing this coating to metal.

986,570. IRON-CLAD ELECTRIC SWITCH. Vernon Hope, Manchester, England. Filed Aug. 10, 1909. A spring-regulated quick-break switch entirely inclosed in an iron casing with only an operating lever protruding therefrom.

986,590. LAMP. William F. Persons, Cleveland, Ohio. Filed Oct. 1, 1910. An electric incandescent automobile lamp is housed in a cylindrical glass casing between top and bottom pieces carrying reflectors.

986,606. TELEPHONE-BODY SUPPORT. Victorien Tardieu, Arles, France. Filed Nov. 29, 1909. A support for mounting a telephone transmitter on the chest of the operator.

986,639. SELECTIVE SIGNALING MEANS. Ira F. Manny, Milwaukee, Wis., assignor to Selective Signal Co., Milwaukee, Wis. Filed Nov. 29, 1909. A motor-driven shaft carries a wheel with escapement teeth engaged by an electromagnetically operated pawl.

986,643. ELECTRICAL RELAY. Charles O. Poor, Rochester, N. Y., assignor to General Railway Signal Co., Rochester, N. Y. Filed Aug. 10, 1908. Comprises an electromagnet whose armature is inclosed in a casing and operates a set of movable contacts.

986,651. SPACE TELEGRAPHY. John Stone Stone, Boston, Mass. Original application filed Feb. 27, 1906. Divided and this application filed March 12, 1908. Comprises a resonant weeding-out circuit including a coil of stranded wire of lengths shorter than the half wave-length of the attuned waves, a condenser and an electrolytic receiver in shunt to the condenser.

986,656. MEANS FOR DRIVING GENERATORS FROM CAR-AXLES. William I. Thomson, Newark, N. J., assignor to Safety Car Heating & Lighting Co. Filed Nov. 13, 1902. Includes a manner of mounting an axle-driven generator and a belt drive therefor.

986,668. REFLECTOR FOR AUTOMOBILE-LAMPS. Percy C. Avery, Milwaukee, Wis. Filed April 29, 1910. A metal reflector for incandescent lamps has attaching lugs cast integral therewith, a circular flange concentrically cast on the rear outer surface thereof, and has an integral polished reflecting surface.

986,702. INSULATOR. David H. Friend, Canton, Ohio. Filed May 24, 1910. Has a conical split head with an angular groove extending into one side at the bottom of the slot in the head.

986,706. ELECTROTHERMOSTATIC ALARM SYSTEM. Albert Goldstein, New York, N. Y., assignor to International Electric Protection Co. Filed Aug. 6, 1910. Comprises the combination in circuit of (1) means for simultaneously producing a certain frequency current and an alarm, and a thermostat controlling this means; and (2) at a distant station, an alarm device responsive only to said frequency current.

986,707. ELECTRICAL-CIRCUIT CONTROLLER AND ALARM. Albert Goldstein, New York, N. Y., assignor to International Electric Protection Co. Filed Aug. 6, 1910. A casing has a partition dividing it into two compartments with two diaphragms on opposite sides of the partition. An electromagnet and a set of contacts are in a circuit actuated by movement of the diaphragms.

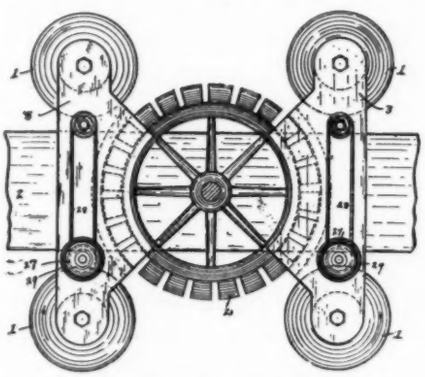
986,708. AUTOMATIC CIRCUIT-BREAKER. Austin E. Greene, South Boston, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Filed June 12 1905. A combined overload and underload circuit-breaker has two separate cores for its tripping coil, one stationary and for excess currents and another movable on failure of the current. Each releases a latch through a common armature.

986,714. ELECTRIC SWITCH. Horace Hull, Denver, Colo. Filed June 15, 1909. Mounted in a casing is a stationary contact and a movable one is placed on the end of a bell-crank lever and actuated by a conductor pull.

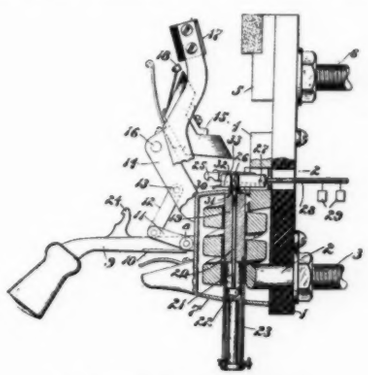
986,743. SOCKET FOR ELECTRIC GLOW-LAMPS. Thomas E. Murray, New York, N. Y. Filed July 24, 1909. Consists of a solid piece of porcelain with a pair of transverse openings opposite the socket cavity for receiving the supporting conducting rods.

986,744. ELECTRIC CUT-OUT. Thomas E. Murray, New York, N. Y. Filed Oct. 25, 1910. Comprises a base block, a fuse case, a detachable cover for the block disposed between the block and case, contacts on the base and cover, and a fuse in the case connected to the cover contacts.

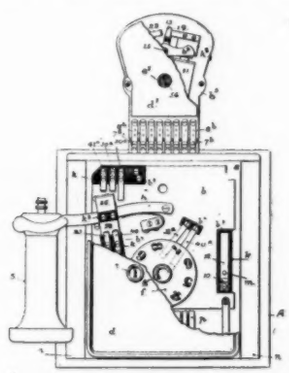
986,748. DYNAMO-ELECTRIC MACHINE. Carl M. Page, Chicago, Ill., assignor of one-half to Horace D. Reynolds, Chicago, Ill. Original application filed Dec. 13, 1909. Divided and this application filed May 2, 1910. A machine capable of use as a generator and as a motor comprises an armature, a shunt-field winding and a series-field winding, the windings being electrically independent, and means for placing either winding in service.



986,554.—MAGNETIC SEPARATOR.



986,708.—CIRCUIT BREAKER.



986,888.—SECRET-SERVICE TELEPHONE.

986,787. TELEPHONE SYSTEM. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Filed Mar. 30, 1907. A relay has two degrees of actuation, a signal being displayed by the partial action and effaced by the complete action of it. Connection terminals are connected to the limbs of the telephone only during actual conversation.

986,805. OPERATING MEANS FOR WASHING MACHINES. William L. Cummer, Hamilton, Ontario, Canada. Filed Dec. 30, 1909. An oscillating rotary motor has its stationary part connected to the washing-machine frame and its rotary part connected to the tub.

986,806. REFLECTOR FOR WIRELESS TELEGRAPHY. Remigius D'Antonio, Capistrano, Aquila, Italy. Filed Jan. 27, 1910. A wireless signaling system for vessels embodies supports provided with adjustable reflectors. The signaling system proper include a transmitter associated with one reflector and a receiver associated with the other reflector.

986,823. ELECTROPLATING-MACHINE. John W. Heaphy, Philadelphia, Pa. Filed June 30, 1910. Comprises a casing for the solution, a rack mounted in the casing, cathodes located in the solution, means for rotating the casing and rack in opposite directions, and means for electrically connecting the cathodes and the rack.

986,842. TROLLEY. John S. McCabe, Bridgeville, Pa. Filed Jan. 24, 1910. The trolley harp is provided with a bearing casing which contains lubricant.

986,843. HANGER FOR TROLLEY-WIRES. William A. McCallum, Cincinnati, O. Filed May 19, 1910. Two strips separated at their upper ends hold the trolley at one point. Both suspend-

ing strips are provided with slots so as to allow both a vertical and longitudinal movement of the trolley wire.

986,845. ELECTRICAL WELDING MACHINE. Elmer E. McIntyre, Pittsburg, Pa. Filed Sept. 23, 1910. A pair of work-supporting members are mounted on a base in such a manner that vertical adjustment may be readily secured. Fluid pressure is applied to the work when the electric current is flowing.

986,887. LOCK FOR SWITCHES. Gottlieb Wuelser, New Kensington, Pa. Filed June 18, 1910. Switch arms are carried on a plate of insulating material, a blade connecting these arms. Means are provided for retaining the blade in engagement with the arms.

986,889. SECRET-SERVICE-TELEPHONE CIRCUITS AND SWITCHING MECHANISM. Albert Koch Andriano, San Francisco, Cal., assignor to Direct-Line General Telephone Co., San Francisco, Cal. Filed March 15, 1905. Each of a number of stations has a home line, and a line-connecting switch contains a terminal for the home line of each connected station.

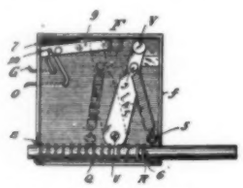
986,952. LOCKING DEVICE FOR TELEHONES. William A. Soles, New York, N. Y. Filed April 22, 1910. The switch lever of a telephone is held down by a padlock.

986,958. ELECTRIC SWITCH. Columbus Woods and Whitman H. Sayles, Peoria, Ill. Filed Dec. 18, 1908. A single switch arm swinging on a pivot is swung through an arc by a spring attached to a sliding rod.

986,991. PULL-CHAIN GUIDE FOR SOCKETS. Owen E. Kennedy, Toledo, O., assignor to Yost Electric Manufacturing Co., Toledo, O. Filed Jan. 6, 1911. A tubular flanged chain guide is attached to a lamp socket.

987,006. CONTROLLER FOR CAR-DOOR MOTORS. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Co. Filed Sept. 20, 1909. The doors of a car are operated by electric motors controlled from either end of the car. Means are provided for locking the controllers when the car doors are closed.

987,036. SAFETY-COUPLING FOR ELECTRIC CONDUCTORS. Angel Belgoder, Mexico, Mex. Filed May 26, 1909. The coupling is provided with slots, members being held against displacement by shoulders.



986,958.—ELECTRIC SWITCH.

987,044. DYNAMO-ELECTRIC MACHINE. James Burke, Erie, Pa., assignor to Burke Electric Co. Filed May 1, 1907. A winding having a commutator, a field magnet, and a dynamo-electric generating winding is connected to a point of varying potential in the first named winding, the second winding having less than one-half the conductors per circuit of the first named winding, and being located in core slots containing conductors of the first named winding.

987,052. THIRD-RAIL BRAKE. William M. Dilliard, Bethlehem, Pa. Filed July 23, 1910. A third-rail brake shoe is mounted so as to be depressed and held against the third rail as may be desired.

987,069. ILLUMINATED ELECTRIC SIGN. Joseph Hotchner, San Francisco, Cal. Filed Dec. 12, 1908. The letters of a sign are illuminated by electric lamps affixed to them.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired March 20, 1911:

516,641. POLICE SIGNAL. Michael J. Burns, Lowell, Mass.
516,642 and 516,643. MAGNETO TELEPHONE. Henry A. Chase, Boston, Mass.
516,651. AUTOMATIC SPEED REGULATOR FOR ELECTRIC MOTORS. William Hochhausen, Brooklyn, N. Y.
516,653. GRAVITY-BATTERY. Lorenzo F. Lary, Pottersburg, O.
516,666. ELECTRIC RAILWAY SYSTEM. Elihu Thomson, Swampscott, Mass.
516,689. INCANDESCENT LAMP. George C. Swan, Brockton, Mass.
516,713. ELECTRIC DEVICE FOR PUMPING OIL WELLS. Harry F. Waite, New York, N. Y.
516,731. ELECTRIC RAILWAY-SWITCH. Charles M. Fitch, South Norwalk, Conn.
516,732. COMMUTATOR. Edward R. Francis, Minneapolis, Minn.
516,740. ELECTRIC APPLIANCE FOR HORSES. George R. King, Dallas, Tex.
516,777. TELEPHONE SWITCH. Alfred Stromberg and Androv Carlson, Chicago, Ill.
516,784. ELECTRIC MOTOR. Philip Wuest, Jr., Philadelphia, Pa.
516,791. CAR-TRUCK. Norman C. Bassett, Lynn, Mass.
516,792. DYNAMO-ELECTRIC MACHINE OR MOTOR. Norman C. Bassett, Lynn, Mass.
516,793. ROTARY BROOM. Norman C. Bassett, Lynn, Mass.
516,794. ARMATURE FOR DYNAMO ELECTRIC MACHINES. Louis Bell, Boston, Mass.
516,795. ARMATURE FOR INDUCTION MOTORS. Louis Bell, Boston, Mass.
516,796. REGULATION OF MULTIPHASE SYSTEMS. Louis Bell, Boston, Mass.
516,797. COIL FOR DYNAMO-ELECTRIC MACHINES. Louis Bell, Boston, Mass.
516,800. INCANDESCENT LAMP AND METHOD OF MANUFACTURING SAME. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass.
516,801. GUARD FOR SHADE-HOLDER FOR INCANDESCENT LAMPS. George W. Demmick, Lynn, Mass.
516,804. METHOD OF TRANSMISSION OF ELECTRICITY. Jonathan P. B. Fiske, Lynn, Mass.
516,805. TRANSMISSION OF ELECTRICITY. Jonathan P. B. Fiske, Lynn, Mass.
516,806. BLOCK SYSTEM FOR ELECTRIC RAILWAYS. John W. Gibboney, Lynn, Mass.
516,807. MOTOR-ARMATURE. John C. Henry, Westfield, N. J.
516,808. OVERHEAD ELECTRIC RAILWAY. John C. Henry, Westfield, N. J.
516,818. ELECTRIC MOTOR. Walter H. Knight, Lynn, Mass.
516,819. INCANDESCENT ELECTRIC LAMP. Edward R. Knowles, Middletown, Conn.
516,820. SOCKET FOR INCANDESCENT ELECTRIC LAMPS. Edward R. Knowles, Middletown, Conn.
516,821. ELECTRIC SEARCH-LIGHT. Edward R. Knowles, Middletown, Conn.
516,822. ALTERNATING ELECTRIC ARC LAMP. Edward R. Knowles, Middletown, Conn.
516,823. ELECTRICAL MEASURING INSTRUMENT. Edward R. Knowles and Lewis T. Robinson, Middletown, Conn.
516,824. ELECTRIC SIGNAL-LANTERN. Edward R. Knowles, Middletown, Conn.
516,825 and 516,826. ELECTRIC ARC LAMP. Edward R. Knowles, Middletown, Conn.
516,827. COMMUTATOR CONNECTION. Charles A. Lieb, New York, N. Y.
516,829. COOLING ELECTRIC APPARATUS. Walter S. Moody, Lynn, Mass.
516,831. STARTING AND CONTROLLING DEVICE FOR ELECTRIC MOTORS. Joseph W. Moore, Lynn, Mass.
516,834. SERIES-PARALLEL CONTROLLER. Edward D. Priest, Lynn, Mass.
516,835 and 516,836. SYSTEM OF ELECTRICAL DISTRIBUTION. Edwin W. Rice, Jr., Swampscott, Mass.
516,837. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. Edwin W. Rice, Jr., Lynn, Mass.
516,839. MEANS FOR MEASURING ELECTRIC CURRENTS. Lewis T. Robinson, Middletown, Conn.
516,840. ELECTRICALLY-OPERATED PUMP. Cyrus Robinson, Lynn, Mass.
516,843. ELECTRICAL HOISTING APPARATUS. Jollon C. Spaulding, Boston, Mass.
516,844. LAMP-SOCKET. Alfred Swan, Schenectady, N. Y.
516,845. METHOD OF CONSTRUCTING COMMUTATORS OF DYNAMOS OR MOTORS. Elihu Thomson, Swampscott, Mass.
516,846. REGULATION OF ALTERNATING CURRENTS. Elihu Thomson, Swampscott, Mass.
516,847. MEANS FOR REGULATING ALTERNATING CURRENTS. Elihu Thomson, Swampscott, Mass.
516,848. ARMATURE-WINDING. Elihu Thomson, Swampscott, Mass.
516,849. ALTERNATING-CURRENT ELECTRIC MOTOR. Elihu Thomson, Swampscott, Mass.
516,850. ELECTRICAL TRANSFORMER. Elihu Thomson, Swampscott, Mass.
516,853. COMMUTATOR CONNECTOR. Ora N. Turner, Lynn, Mass.
516,855. ELECTRICAL MEASURING INSTRUMENT. Elmer G. Willyoung, Philadelphia, Pa.
516,876. CONDUIT FOR ELECTRIC RAILWAYS. Herlup A. E. Petersen, Milwaukee, Wis.
516,878. ELECTRIC CIGAR LIGHTER. Joseph Sachs, New York, N. Y.
516,879. FIRE TELEGRAPHY. Sydney J. Sanford, Barrie, Canada.
516,892. INCANDESCENT LAMP. Rudolf Langhads, Berlin, Germany.
516,903. RAILWAY SIGNALING AND SWITCHING APPARATUS. John D. Taylor, Chillicothe, O.
516,916. ELECTRIC MOTOR. Clyde J. Coleman, Chicago, Ill.
516,917. ELECTRIC MOTOR. Clyde J. Coleman, Chicago, Ill.
516,956. ELECTRIC ELEVATOR. Robert Watson, Washington, D. C.
516,982. TELEPHONE. Anthony C. White, Boston, Mass.
517,000. ELECTRICALLY-OPERATED RAILROAD TURN-TABLE. Howe E. Dazenbaker, Philadelphia, Pa.
517,009. EXTENSION ELECTRIC CHANDELIER. Arthur McLean, Ansonia, Conn.